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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

CONDUCTED BY

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VOL. XII.—SECOND SERIES.

LONDON:

PRINTED AND PUBLISHED BY TAYLOR AND FRANCIS.

SOLD BY LONGMAN, BROWN, GREEN, AND LONGMANS; S. HIGHLEY; SIMPKIN, MARSHALL, AND CO.; PIPER AND CO.; W. WOOD, TAVISTOCK STREET; BAILLIÈRE, REGENT STREET, AND PARIS: LIZARS, AND MACLACHLAN AND STEWART, EDINBURGH: CURRY, DUBLIN: AND ASHER, BERLIN.

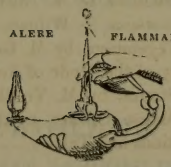
1853.

"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quelque soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.

. . . . . The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.



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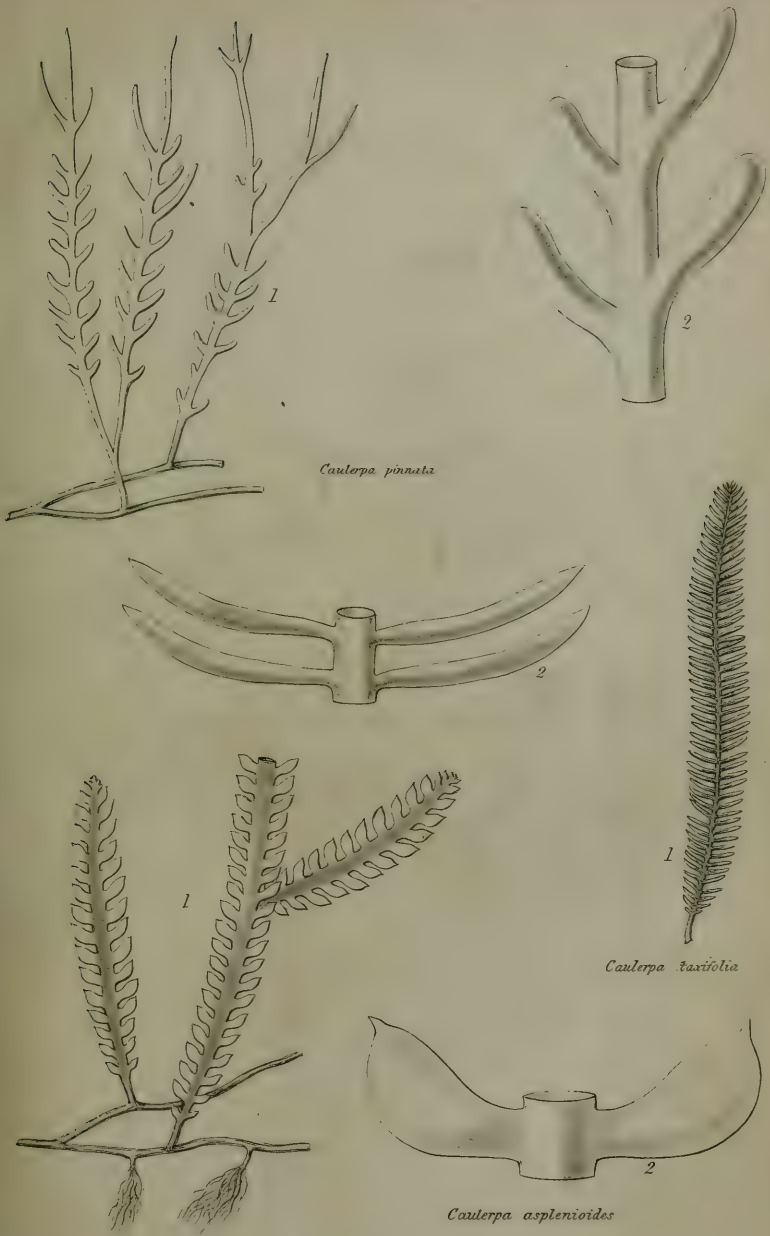
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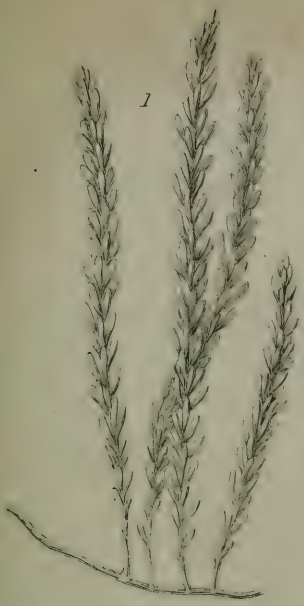
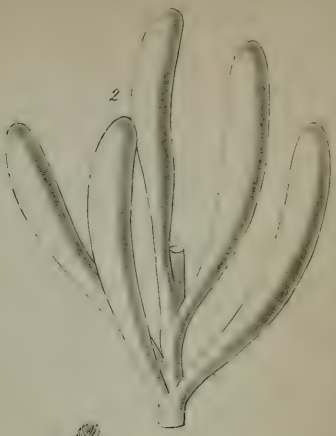
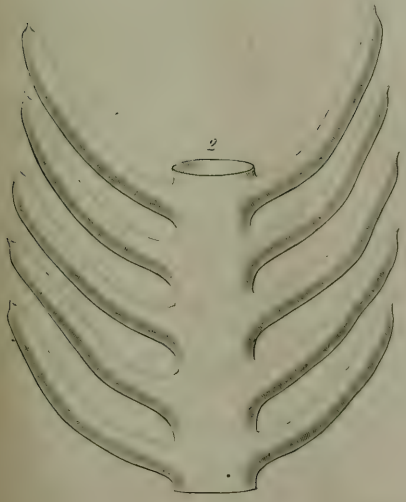


Caulerpa laxa





Caulerpa fissidentoides

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ZOOLOGY

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

" ..... per litora spargite muscum,
Naiades, et circùm vitreos considite fontes :
Pollice virgineo teneros hìc carpite flores :
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas ;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasii Ecl. 1.

No. 67. JULY 1853.

I.—*Remarks on some Algæ belonging to the Genus* Caulerpa.

By R. K. Greville, LL.D. &c.*

[With two Plates.]

AMONG the Algæ collected by Dr. Wight on the shores of the Peninsula of India are various *Caulerpæ*. Of described species the following may be enumerated: *Caulerpa Lessoni*, Bory; *plumaris*, Ag.; *scalpelliformis*, Ag.; *sedoides*, Ag.; *Chemnitzia*, Lamour., and *Freycinetii*, Ag.

There are also two or three other species upon which I propose to offer some remarks. The first of these is the plant described by Agardh as var. *β. crassifolia* of his *Caulerpa taxifolia*; at least there can be no doubt that it is the form quoted by him, and figured by Turner in 'Historia Fucorum,' tab. 53, as *Fucus pinnatus* of Linnæus. I am, however, very sceptical of its having any specific relation to *C. taxifolia*, typical specimens of which I possess from Agardh and Hornemann. The frond of the latter is pinnated in a definite, symmetrical and uninterrupted manner, answering well, in fact, to Agardh's description: "pinnis æqualibus simplicibus fere horizontalibus, parallelis . . . . basi apice-

* Read before the Botanical Society of Edinburgh, April 14, 1853.

que attenuatis, oppositis, approximatis." The Indian plant, on the contrary, is remarkably straggling and irregular in its habit; the pinnæ remote, often interrupted, unequal in length, and instead of being nearly horizontal are given off at a considerable angle, with a decurrent base. Turner has well remarked of this plant, that "young specimens are entirely destitute of pinnæ, and resemble in their naked filiform branches, as well as in their colour, texture and substance, battered plants of *Chara flexilis*. Judging from some of Dr. Wight's specimens, it is not improbable that even older individuals may retain this form when vegetating in situations unfavourable to their perfect development. It may be added, that, as far as I am aware, the true *C. taxifolia* is a native of the West Indies, while the Alga under consideration has only been found in the Red Sea and in the East Indies.

Presuming then that Turner and Agardh are correct in regarding our plant as the *Fucus pinnatus* of Linnæus, I venture to suggest that it take its place in the genus as *Caulerpa pinnata*. A figure representing the frond in a somewhat younger state than in Turner's work will be found in one of the plates which accompany this paper (Pl. I.).

Before I proceed to describe the remaining *Caulerpæ* referred to in Dr. Wight's collection, there is another Alga of which it is desirable to take some notice in connexion with the preceding species. This is a very beautiful plant which was communicated to me by Professor Mertens, many years ago, as collected at the island of St. Thomas in the West Indies, and likewise named *Fucus pinnatus* of Linnæus. It is, nevertheless, as far removed from *Caulerpa pinnata* above mentioned as from *C. taxiformis*. It is closely and regularly pinnate, the pinnæ oblong-obovate and more or less falcate as in *C. scalpelliformis*, but (unlike those of the latter) given off horizontally; and the frond is besides truly pinnate, not pinnatifid. For this plant I propose the following character:—

Caulerpa asplenioides (nobis); frondibus pinnatis, pinnis oppositis, subhorizontalibus, obovato-oblongis, falcatis, obtusis, abrupte apiculatis.
Caulerpa taxifolia, var. *crassifolia*, Ag.
Fucus pinnatus, L. Mertens in litt.

Although my friend Agardh has in his description of *C. taxifolia* quoted Turner's figure of *Fucus pinnatus* as a representation of his variety *crassifolia*, I cannot help assuming that he included our present plant also, for under *Caulerpa scalpelliformis* he remarks, "Simillima Caulerpæ taxifoliæ, var. crassifoliæ, sed distincta fronde magis confluente, potiusque pinnatifida quam pin-

nata, pinnis obtusis, crassis." I may add in conclusion that the stems and branches of *C. asplenioides* are comparatively tough and opake, and bear no resemblance to those of *C. pinnata*, which Turner has so graphically compared to battered plants of *Chara flexilis*.

In order to assist in confirming my views regarding these species, I refer to the illustrations on Plate I., viz.—

Caulerpa taxifolia. Fig. 1. A portion of the frond, natural size. Fig. 2. A portion magnified.
Caulerpa asplenioides. Fig. 1. A portion of the frond, natural size. Fig. 2. A pair of the pinnæ magnified.

Caulerpa laxa (nob.) ; frondibus simplicibus, ramentis lineari-clavatis apice rotundatis undique laxe imbricatis.
Hab. in mari Peninsulæ Indiæ Orientalis ; Wight.

This species is allied to *Caulerpa clavifera*, but is altogether a more slender plant. It has, indeed, a moss-like habit, at least after having been dried, quite unlike *C. clavifera*, with authentic specimens of which I have compared it ; and still more unlike *Fucus Lamourouxii* and *Fucus uvifer* of Turner, which are considered as varieties of that species by Agardh. The ramuli vary considerably in different individuals with regard to their length and in the degree in which they are thickened upwards ; but they are always gradually clavate and rounded at the extremity ; a double character which at once separates it from *Caulerpa Selago* and its allies, including a beautiful new species (*C. furcifolia*, Harv.) collected in New Zealand by Dr. Sinclair, and presented to me by my friend Mr. William Gourlie.

Plate II. fig. 1. *Caulerpa laxa*, natural size. Fig. 2. Ramuli magnified.

Caulerpa fissidentoides (nob.) ; frondibus compacte pinnato-pectinatis ; pinnis adscendentibus, linearibus, obtusis, apiculatis, oppositis.
Hab. in mari Peninsulæ Indiæ Orientalis ; Wight.

It is with very considerable hesitation that I venture to separate this plant from *Caulerpa plumaris*, and I confess that I am unable to define it satisfactorily. At the same time the habit is very different, closely resembling that of a gigantic *Fissidens*. It is more rigid and less slender in all its parts than *C. plumaris*, the pinnæ shorter and much less capillary, and although given off horizontally as in that plant, they immediately assume a more upward direction. The rachis too (if I may be allowed the term for convenience sake) is relatively broader, so that the pinnæ are often not more than equal to twice or thrice the width of that part. I am not disposed, however, to lay much stress upon the length of the pinnæ, because this character is extremely va-

riable. In specimens of *C. plumaris* from the West Indies communicated by Agardh and Mertens, the pinnæ are very nearly twice as long as in other specimens from the East Indies and the Cape of Good Hope; and we must not forget that their extreme length (nearly 1 inch) forms the only specific difference of *Caulerpa longifolia*, an Australian species. With regard to the pinnæ of these perplexing forms I may further add, that, in not being attenuated at the base, they are completely separated from *Caulerpa taxifolia*.

PLATE II. fig. 1. *C. fissidentoides*, natural size. Fig. 2. A portion of the frond magnified.

II.—*On the Genus* Truncatella. By WILLIAM CLARK, Esq.

To the Editors of the Annals of Natural History.

GENTLEMEN, Exmouth, June 8, 1853.

MR. WM. THOMPSON of Weymouth has this day favoured me with some lively examples of the rare *Truncatella Montagui* in its adult and young states, that is, before and after the truncature of the apex, and also others of the still rarer *Rissoa littorea* of authors; these, though sent by post in moistened weed, which however was quite dry when received, on being put into sea water immediately deployed the organs. The first has been described by the Rev. R. T. Lowe, many years ago, in the 5th volume of the 'Zoological Journal,' p. 303; and the *R. littorea* by the learned authors of the 'British Mollusca' in the Appendix, vol. iv. p. 265; still, as my account contains many new particulars, and notes a difference of opinion in respect of the generic position of *R. littorea*, I have thought it would be agreeable to some of your readers to have an accessorial description of these rare creatures from a fresh though inferior hand, especially as the present notes exhibit a comparative view of both animals, which were examined for two days in the same vase under very favourable circumstances. It is singular that these species, both undoubted Pectinibranchiata, should inhabit at high water level, in company with *Conovulus denticulatus* and *C. bidentatus*, both Pulmonifera, and are, as Mr. Thompson has informed me, "decidedly amphibious," being often found far above that limit; but I apprehend not more so than many of the minuter *Littorinæ*, particularly *L. neritoides*, which are attached to rocks for long periods, perhaps during their whole existence, above the highest tides and even beyond the reach of the spray, living apparently on the floating saline moisture. It would appear then that the two

respiratory systems are in respect of these animals on the limits of their respective boundaries, and form the transitions from one to the other. Both the Pectinibranchiates escaped from the water as quickly or quicker than the Pulmonifera, but all the former, whether littoral or from deep water, have the same propensity; therefore this fact is of little value; yet, when strictly confined, the *Truncatellæ* continued lively for two days, whilst the *Conovuli* became torpid in twelve hours: perhaps we may conclude that these littoral Pectinibranchiata and the sub-littoral Pulmonifera are to a certain extent amphibious. All these species were taken mixed together in an estuary at Portland by Mr. Thompson, who states that they are very rare and local.

Truncatella Montagui, Lowe.

Truncatella Montagui, Brit. Moll.

Animal, when adult, occupying a yellow or whitish subcylindrical shell of four flattish volutions deeply divided, and furnished with close-set somewhat irregular costellæ; when young, before the apex is truncated, of 6–8 smoother and more taper gyrations; the peristome in the completed shell is entire, having the outer lip blunt and a little reflexed; with respect to colour, it is of the palest yellowish white, aspersed with very minute flake-white points, particularly the foot, with a patch of pink on the neck caused by the colour of the buccal corneous plates showing through the pellucidity of the tissue. The mantle is plain and even with the shell, but rather tumid at the margin: I did not observe much approach to the mantellar collar of the *Helices*. The rostrum is ridged or annulated, long, very broad, flat, emarginate at the end, forming on each side a curved compressed auricle, and cloven underneath vertically and slightly crosially; buccal apparatus reddish pink; the tongue at its deeply seated terminus displays a pair of white jaws; it can be seen through the œsophagus, and is accompanied on each side by a linear streamer floating loose posteally. I am not certain whether these narrow tape-like additions proceed from the buccal membrane or tongue,—I think the latter,—or they may possibly be salivary glands.

The branchial plume is single, of an elongated kidney-shaped figure, and has the usual constriction or sinus at the end nearest to the heart; it can be detected with high powers in sunlight, through the body volution of pale, clear, thin shells; all the rest of the organs, including the single pale brown ganglion on each side the œsophageal collar on its upper surface, may be easily seen through the hyaline tissue of the neck and head. The neck and rostrum from its corrugations can be protruded to an extra-

ordinary extent beyond the aperture; the head far exceeds the tentacula in length; these are short, flat, broad, subtriangular, and diverge greatly, scarcely forming an angle of 25°; the eyes are large and black, and have *white* prominent pupils, which visibly dilate and contract. I have never observed such in any mollusk, though similar ones may have escaped notice; they are placed a little nearer to the base than the middle of their lower half, not on pedicles, but quite flat on the centre of subsemicircular expansions of the outer sides of the tentacula, with an external tendency. Foot thick, steep, oval, very little extended, and on the march maintaining posteally and anteally the oval contour, with a vermicular motion, like an advance of one half to the other; this action gives an apparent crease simulating an incised transverse line, but on the step being completed the foot becomes entire; it carries very posteally on a plain upper lobe, without an appendage of any sort, a narrow, irregularly oval, light yellow corneous operculum, rounded at the outer margin and basally, straighter next the columellar side, and contracted at the upper angle; the nucleus of the spire is at the base, with a single turn, which, though indistinct, is in certain lights, with good glasses, quite visible; its surface is coarse and corrugated, and marked with rough, somewhat oblique, not equidistant striæ or ridges. The rostrum is medially longitudinally finely grooved, which character extends through the neck as far as can be seen, probably as a guide channel to the branchial leaf. The neck, with this exception, is plain. The animal is not shy, but does not creep with much rapidity; its progression is a modification of the littorinidan vermicular character. That *Truncatella* is a littorinidan genus admits of no doubt; the very paucispiral operculum, pair of jaws, and single branchial plume sufficiently attest this determination; its position is of course closely connected with *Rissoa*.

Truncatella littorea, Della Chiaje.

Truncatella littorina, Philippi, Moll. Siciliæ.
Rissoa et Assiminia littorea, nonnull.

Animal inhabiting a minute pale yellow shell, not $\frac{1}{10}$th of an inch high, or in transverse measure, of four rather tumid volutions, the first three of small areas, the body being more than $\frac{3}{4}$ths of the bulk of the whole; under powerful lenses in some specimens the rudiments of the longitudinal costellæ or striæ of *Truncatella Montagui* are visible, an important corroborative character; the peristome is complete, but sharp-edged. The animal is of the palest yellowish white, sprinkled with excessively minute flake-white points, particularly on the sole of the foot, with

the slightest tinge of brown on the neck, the effect of that colour in the buccal plates declaring itself through the membranes. Mantle plain and thickened at the margin. Rostrum annulated, but not so long in proportion as in its congener, broad, flat, emarginate at the extremity, forming on the right and left a flattish arcuated lobe; beneath, vertically and slightly crosially cloven, having the usual corneous buccal plates, tongue, and pair of white jaws. Tentacula very short, broad, flat, rounded at the end, divergent, both in quietude and on the march to almost right angles, with large eyes and dilatable white pupils as in the preceding species, placed not positively at their terminations, but on the centre of the membrane, at some distance from the extreme points: this was particularly remarked; but the very powerful lens used would give them that appearance, which of course would not be so apparent when viewed by a common glass; though, nearer the extremity of the tentacula, the characters are precisely those of *T. Montagui*, and a similar white pupil is a singular coincidence. The neck, as in its congener, has the same longitudinal groove or canaliferous lines running medially through the rostrum and neck to the branchial leaf, and is doubtless an aqueduct. The neck and rostrum in quietude appear short; they are so in *T. Montagui*, but can in like manner be greatly extended, though not proportionately so much; for these reasons the branchial streamlets and nervous ganglions were not seen: but I distinctly observed, through the tenuity of the shell, the kidney-shaped respiratory apparatus with the constriction at the end nearest to the heart, and clearly detected the fine blood-vessels of the reniform loop ranged in transverse order. The only difference observable in the two species is, that in this, the leaf appears of a shorter or more oval contour, more compact, and with a less deep constriction; the neck and rostrum have no additions beyond the groove and annulations. Foot thick, having a more elongated oval shape than in its congener, and, as in it, on the march is rounded in front and behind; it simulates the same transverse crease or line on the sole, and has a like character of progression. There is a simple, almost terminal, but decided operculigerous lobe that bears a light corneous suboval operculum, which in all points, except being of lighter colour and broader oval, is identical with that organ in the preceding species to which I refer; indeed so great is the similarity of the two animals, that I might by a reference have condensed the greater part of this account; but as these notes are decidedly comparative of two particular creatures, I have, for impression, given them *in extenso*. The animal is free, but deliberate on the march, and carries its shell very upright, at near an angle of 75°–80° from the horizon.

It will be seen that this account is essentially the same as the one in the 'British Mollusca,' except that the learned authors have proposed to deposit it in *Assiminia*. I think its generic position is with *Truncatella*. A comparison of the two species will show that they are not only identical in the principal characters, but almost all the minutiæ are congruous. Indeed I may say, that these gentlemen differ little more from me than in the name, '*Assiminia*,' which I would gladly accept for *Truncatella* for the reasons below, if such a change in nomenclature were not forbidden by strict conventional laws. As far as I can learn, not having seen the animal of *A. Grayana*, the genus *Assiminia* scarcely varies, if at all, from *Truncatella*; at least the generic characters given in the 'British Mollusca' are absolutely those of that genus, except some difference in the position of the eyes, which I shall not be surprised to find turns out greater in terms than in reality.

I wish some naturalist would send me *here* some live examples of *A. Grayana*; they inhabit the Greenwich and other eastern marshes about London: if sent by post the same evening when taken, in a small, strong, wooden, *turned* box of the size of half-a-crown, with a little weed or dry moss only slightly moistened in the water of their habitat, they would probably arrive sufficiently lively for examination. Even the shells, if with the opercula, would enable me to give a qualified opinion on their position.

The generic title of *Truncatella* is objectionable, as being in this case too distinctive, and therefore only strictly applicable to *Truncatella Montagui*, whilst two, if not three, of our indigena, *T. littorea*, *T. Grayana*?, and *T. nitidissima*?, are never truncate at the apex; still, this appellation has been so long established, that it is better to continue it than add new names to science:—the latter remarks are M. Philippi's sentiments. We have here a striking illustration of the value of conchological made genera, as, in consequence, three species of one genus have received as many generic titles, from their shells exhibiting a subcylindrical, a conical, and a discoid form (if the *Skenea*? *nitidissima* of authors is the *T. atomus*? of Philippi, as is probably the case).

I see no reason to doubt M. Philippi's *Truncatella littorina* (Moll. Sicil. vol. ii. p. 133. tab. 24. fig. 2) being our present species; the description and figure entirely accord.

It is stated by me in a former paper in the 'Annals' that this is an apocryphal British species;—the refutation is now sufficiently complete.

I am, Gentlemen,

Your most obedient servant,

William Clark.

III.—*On the Operculum of the Genus* Diplommatina.

By Dr. J. E. Gray, F.R.S., V.P.Z.S. &c.

To the Editors of the Annals of Natural History.

Gentlemen,

If Mr. Benson, before writing his observations on this genus which appeared in the preceding Number of the 'Annals' (vol. xi. p. 433), had taken the trouble to come and examine the specimens of *Diplommatina* in the British Museum on which Dr. Pfeiffer and I had founded our observations, he would have found that there was not the slightest ground for any of the arguments which he has used to induce naturalists to believe that the opercula described as belonging to the genus could have been accidentally placed in the shell, and thus excuse the imperfection which occurs in his and Capt. Hutton's description of the animal; and further, he could never have made the extraordinary suggestion that the opercula belonging to *Diplommatina* "were adventitious," and might be "assignable to the young *Alycæus strangulatus*," for the opercula of the two genera are most unlike in structure and colour, and that of the latter genus is at least five times as large as the largest species of the former.

The opercula of the three species of *Diplommatina costulata* in the Museum are each attached to the dry remains of the animal; two of the animals are still in the shell, and the third was extracted from the shell for the purpose of more accurate examination.

It is easy to understand, when we consider the minuteness of the operculum, its small size compared with that of the mouth of the shell, and its transparency, how it may be overlooked, especially when it is sought for in the curious manner mentioned by Capt. Hutton. I have a strong suspicion that if Mr. Benson's specimens were more carefully examined, the operculum would be discovered, unless the animal has been eaten out of the shell by insects.

The operculum of *Acme fusca*, so common in many parts of England, which is of about the same size but darker, was overlooked by many malacologists, and has been denied after it was described by others, as is the case with that of *Diplommatina*.

I may observe, merely to try to clear away certain theories which continue to cling about malacology, that I cannot consider "the existence of the tooth-like plait on the *columella*" of any force as "militating against the theory of an operculum" in this genus, for we now well know that *Pyramidella*, *Odostomia* and

Actæon, and sundry other genera which have tooth-like plaits on the columella, have opercula.

Secondly, Mr. Benson must excuse me if I suspect he has mistaken some adventitious membrane for an epiphragm, for I have never seen a true epiphragm which extended "even over the reflected portion on the parietes" of the mouth; indeed such an extension is inconsistent with the manner in which the part is deposited.

June 1, 1853.

IV.—*Description of a new species of Rhododendron from Bootan, in India.* By Thomas Nuttall, Esq.

Rhododendron Kendrickii.

Frutex ramosus; foliis oblongo-lanceolatis, acuminatis, glabris, concoloribus, margine leviter undulatis, junioribus pubescentibus; corymbis multifloris; laciniis calycinis minutis, acuminatis; (staminibus 10?) filamentis glabris; capsulis arcuatis, glabris, 6-locularibus; seminibus lanceolatis, utrinque acutis.

Hab. Mountains of Bootan (Mr. Booth). About 7000 feet elevation, accompanying *R. Edgworthii*, and found lower down than *R. Hookeri* and *R. Falconeri*, but above *R. serotinum*.

This fine species, having some affinity with *R. arboreum*, forms lofty thickets (after the manner of *R. ponticum*), through which the traveller finds dark and difficult paths. The stem attains the diameter of 7 or 8 inches, with a smooth pale bark. The leaves, 4 to 6 inches long, are scarcely more than an inch wide, elegantly waved on the margin in small plaits, so as to appear almost crenate, disposed partly in whorls, equally green and smooth on both surfaces when adult, the petiole less than half an inch in length; the young leaves and stems, in young plants, more or less clothed with reddish glutinous hairs; beneath, shining, with the pubescence chiefly confined to the midrib. Flower-cone oval, the scales smooth, rounded and obtuse; innermost scales or bracts silky. Corymb 10- to 12-flowered. Flowers large, deep red. Stamens 10? smooth. Stigma 5-lobed. Calyx small, as in *R. arboreum*, the segments broad, ovate, acuminate. Capsule 1 to $1\frac{1}{4}$ inch long, incurved, 6-celled, smooth and dark brown. Seeds small, darkish brown, lanceolate, oblique, acute at both extremities.

It grows promiscuously with the very hardy *Pinus excelsa*, and with several kinds of undescribed oaks. Found to be hardy in the climate of England. Fresh flowers have not yet been seen,

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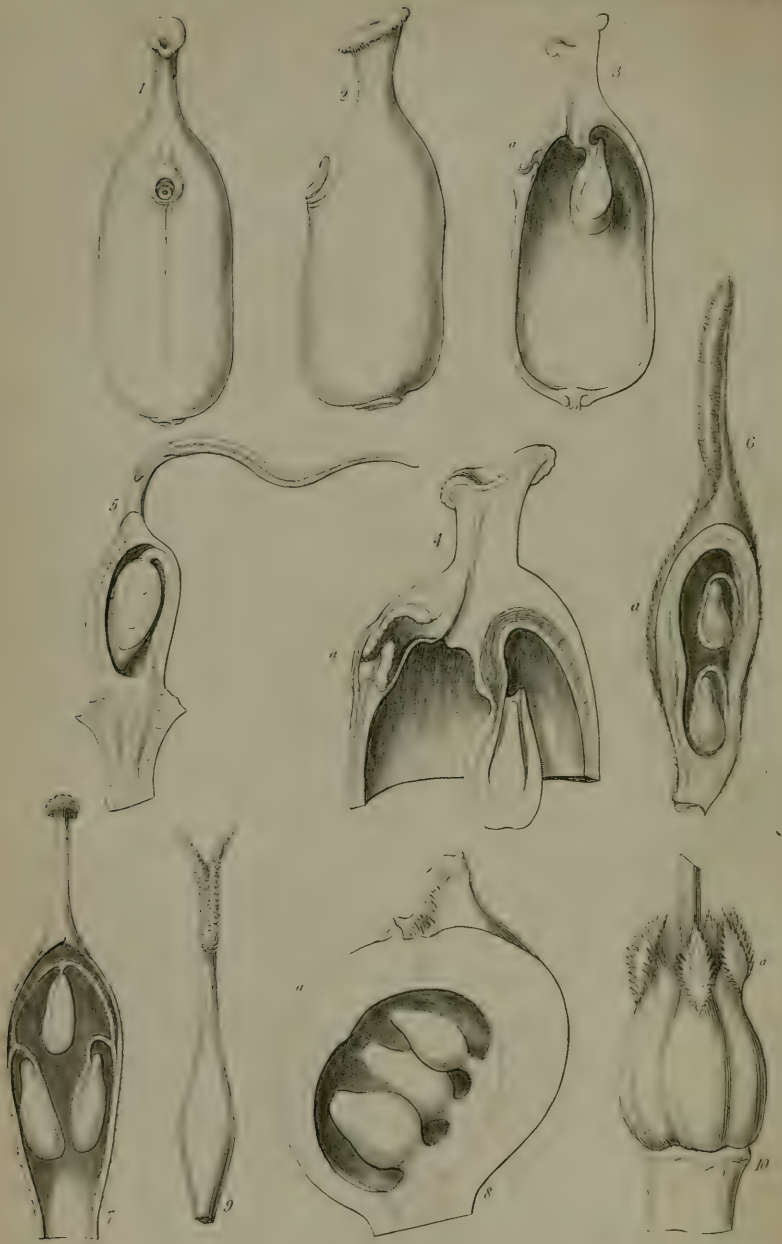
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but from the appearance of dried fragments they seem to be of a deep red.

According to the herbarium of my friend Sir William Hooker, it appears that this species was observed in Bootan by the late Mr. Griffith. The specimens referred to are branches without flowers or fruit.

Dedicated to the memory of my much-revered friend and botanist, the late Dr. Kendrick of Warrington.

V.—*On Relative Position; including a new Arrangement of Phanerogamous Plants.* By B. Clarke, F.L.S. &c.

[With a Plate.]

Part IV.

On Dorsal Placentation.

The instances in which this variation from usual placentation takes place deserve particular attention as having a direct bearing on affinities, the structure of the ovary, and the position of the carpel when single; but this involves a question relating to the structure of the ovary of *Nelumbium* which requires to be first more particularly noticed. The discovery that in this genus the raphe of the anatropal ovule is turned away from the adherent funiculus, has been the occasion of an extended inquiry into the structure of its remarkable ovary, and repeated examinations in different stages of its development have led to the conclusion that the carpels always stand with the ventral suture outwards, that is, turned towards the stamens.

The cause of this singular departure from ordinary structure is however difficult to explain, but seems owing to one of the following circumstances:—1. Either the real ovary is rudimentary, consisting only of the disk in which the carpels are immersed, and the carpels themselves belong each to a separate flower (each rudimentary carpel producing from its base one female consisting of a single carpel); or, 2. the ovary is apocarpous as generally understood and the carpels are turned outwards.

In support of the first hypothesis, it may be observed that the disk in which the carpels of *Nelumbium* are immersed differs from such structures in other families in being continuous with the stem, in consisting internally of irregular cavities separated by thin walls, and in containing an abundance of spiral vessels. But supposing that this were its structure, it might be expected that as each carpel belonged to a separate flower there would be some

variations in its position; but this is not the case, as the carpels have regularly the ventral suture turned outwards; and this suggests the idea that carpels (like leaves revolute in vernation) may be formed by the margins of the carpellary leaves being turned, and meeting outwards instead of inwards. May not stamens also, being turned outwards or inwards, be analogous in some cases to the vernation of leaves? In *Tormentilla officinalis* I have observed carpels among the stamens (stamens metamorphosed?) having the ventral suture apparently outwards, the tendency of the anthers being also to open outwards. But as in *Ceratophyllum* and *Piperomia* the carpels are all posterior, the uniformity of the position of the carpel in *Nelumbium* forms only a partial objection, and the former is probably the true solution of the question.

A further argument in support of the hypothesis that in *Nelumbium* the ovary has the ventral suture turned outwards, is derived from the fact that in the Nymphal Alliance the placentation is, as Mr. Brown has remarked, dorsal, variations even when they do take place being only partial; for supposing the carpel to be so placed, *Nelumbium* agrees in this character also in the adherent funiculus being always at the inner angle of the carpel (Pl. III. figs. 1, 2, 3 & 4). The occurrence of dorsal placentation in other families allied more or less nearly also makes it probable that this is the true structure of *Nelumbium*, and on this account an especial notice of them may be the more interesting, passing over those in which the ovules are numerous, viz. Orobanchaceæ (in some genera only), Nymphæaceæ, Butomaceæ, and possibly Hydrocharideæ.

1. *Hydropeltis purpurea.* Ovules two, pendulous, anatropal, having the raphe turned away from the placenta, and attached one above the other to the dorsum of the carpel*. (Pl. III. fig. 6.)

2. *Cabomba aquatica.* Ovules three, pendulous, anatropal, having the raphe turned away from the placenta (occasionally lateral?), one attached to the ventral suture near the apex of the carpel, and the two others to its sides midway between the dorsal and ventral sutures. These two ovules are attached to two cord-like ribs which originate in the base of the cell, and are continued upwards to the attachment of the third ovule. (Pl. III. fig. 7.)

3. *Ceratophyllum demersum.* Ovule single, pendulous from the apex of the cell in consequence of the funiculus to the apex of which it is attached being firmly adherent to the dorsum of the carpel. This funiculus originates in the base of the carpel

* That the ovule is anatropal is further shown by the embryo being next the hilum.

as in *Nelumbium*, and is always more or less distinctly visible in the early stages of the flower* (Pl. III. fig. 5). From this character the nearest affinity of *Ceratophyllum* may be, as first suggested by Dr. Asa Gray, with *Nelumbium* rather than with Piperaceæ, which, from the position of its carpel, I formerly supposed might be its true station. Its habit however is more that of *Cabomba*, with which it agrees in the stamens being turned outwards instead of inwards, as in *Hydropeltis*; it may also be regarded as having some analogy with Hydrocharideæ in its orthotropal ovule, exalbuminous seed and unisexual flowers, and possibly with *Cryptocoryne* in its many-leaved plumule, and it further agrees with Hydropeltideæ in its cellular leaves.

4. *Chloranthus*. The ovary of this genus agrees with that of *Ceratophyllum* in always having the appearance of a funiculus arising from its base which is constantly attached to the posterior side. That the posterior is the dorsal side of the ovary is the most probable, as the stigmatic tissue always descends on its anterior side, having first obliquely crossed its thickened summit; and that this is the true structure of *Chloranthus* is placed almost beyond doubt by the carpel in *Piperomia* and in *Houttuynia* when single being always posterior. (See the figure of *Chloranthus* accompanying Part III.)

5. *Arum maculatum*. Ovules five or six ascending, always attached to the posterior side of the carpel (its lower half); stigma having its anterior surface only stigmatic as in Piperaceæ, the posterior being not unfrequently almost vertical and rounded (Pl. III. fig. 8). Although it may not be considered as fully demonstrated that in *Arum* the carpel is posterior, yet it is obvious that it must be either always anterior or always posterior, and as it is variable and more frequently posterior in Typhaceæ, it is very improbable that it is always anterior in *Arum*, and a comparison also with *Cryptocoryne* may perhaps be adduced as a further argument. In genera nearly allied to *Arum* the placentation is however not dorsal, but the ovules being partly sutural in *Cabomba* and entirely dorsal in *Hydropeltis*, shows that this difference of placentation may take place in genera very nearly allied, if not in the same genus, as in *Mesembryanthemum*.

Cryptocoryne. From Mr. Griffith's figures of *C. ciliata*

* The following circumstance seems also to show the placentation of *Ceratophyllum* to be the same as that of *Nelumbium*. Having three immature fruits of *Ceratophyllum demersum*, I allowed them to remain growing on the plant to produce seeds. But some time afterwards having observed an altered appearance in one of them, I found on examination that the ovary had entirely decayed away, leaving the ovule suspended from the apex of a filiform perfectly entire funiculus which was posterior, and both funiculus and ovule remained attached to the torus quite free from decay for two or three days afterwards.

(Pl. III. fig. 10) it may be expected that this genus is another instance among Araceæ in which the placentation is dorsal, as the fissure of the stigma is in two instances represented as taking place toward the axis (Trans. Linn. Soc. vol. xx. tab. 10). Fissures occurring in the stigmas of single carpels are generally, if not without exception, dorsal, and in *Sparganium ramosum* such fissured stigmas are not unfrequent, the fissure being always dorsal (Pl. III. fig. 9), which is so far a reason for regarding the 5–7-celled ovary of *Cryptocoryne* as produced by the carpels of as many separate flowers. As thus understood all the carpels are posterior having their placentation dorsal, and become adherent, so as to form in appearance one polycarpous ovary; and although this may appear problematical, it would be difficult to account for the structure of *Cryptocoryne* on the ordinary rules of carpology, as Mr. Griffith alludes to other species in which the carpels are more numerous, and adds that he should not be surprised if species be found to exist with ovaria disposed in two or more series, which then would nearly approach *Arum*.

The ovaries of different flowers becoming confluent so as to form a syncarpous mass is not without parallel, as in the monstrous ovaries of *Matthiola incana* it is a very common irregularity that two ovaries, and also three standing in a row, form only one cavity; the confluence taking place at the dorsal suture, or so near it as to be in each case intermediate between the two placentæ, from which it seems possible that this may take place as a regular structure. And in *Opercularia* also adhesions take place between the capsules constituting the small whorls of fruits which remain permanent after complete dehiscence has taken place.

While however dorsal placentation forms an important deviation in the structure of ovaries, its value as a character in separating near allies is but weak, *Monodora* among Anonaceæ being a remarkable example of ovules deriving their attachment from the whole of the inner surface of an ovary consisting of a single carpel, and that in an Alliance which has otherwise ordinary modes of placentation. But, on the contrary, those families in which it occurs may on that account prove to have a direct affinity to each other; and it most probably is, in common with the posterior position of the carpel, and the raphe averse in pendulous anatropal ovules, an Endogenous character, and shows an approach (where it occurs) on the part of Exogens to Endogens.

EXPLANATION OF PLATE III.

Fig. 1. The external appearance of a carpel of *Nelumbium speciosum*, showing the ventral tuberosity which is always turned towards the stamens.

Fig. 2. The same as seen laterally.

Fig. 3. A longitudinal section of it: *a*, the ventral tuberosity. The fumi-

culus is seen adherent to the opposite side, and the axis of the style is seen inclining to the ventral tuberosity.

Fig. 4. The same more magnified, showing the cellular somewhat circuitous canal which extends from *a*, the ventral tuberosity, to the cavity of the ovary; the external and internal openings being closed only by a thin layer of cellular tissue: the axis of the short style, together with its termination in the cavity of the carpel external to the funiculus, and also the fibres of the funiculus, are here distinctly seen.

Fig. 5. An ovary of *Ceratophyllum demersum* in longitudinal section.

Fig. 6. A carpel of *Hydropeltis purpurea* in longitudinal section: *a*, the ventral side which is turned towards the axis of the polycarpous ovary.

Fig. 7. A carpel of *Cabomba aquatica*, the dorsum having been removed. Two ovules are seen attached to the lateral fibres, which are continued upwards and meeting at the ventral suture become continuous; at this part the third ovule is seen attached.

Fig. 8. An ovary of *Arum maculatum* in longitudinal section: *a*, the anterior side.

Fig. 9. An ovary of *Sparganium ramosum* in which the dorsal portion of the stigma had become fissured; when dicarpous, which frequently happens, the stigmatic surfaces of the two carpels are turned towards each other.

Fig. 10. *Cryptocoryne ciliata*: *a*, the fissured stigma. (Griffith.)

VI.—*On the Phosphorescence of some Marine Invertebrata.*

By M. A. De Quatrefages*.

I. *Historical review of the Subject.*

1. *Causes of phosphorescence.*—It is well known that the waters of the sea, in some latitudes and under certain circumstances, are phosphorescent, producing a light more or less brilliant. This remarkable phænomenon has always attracted the attention of travellers, and various have been the explanations they have offered. Without going here into useless detail, we will first mention those hypotheses which are now completely set aside, before dwelling on better-founded opinions.

Ancient navigators seem to have indicated a resemblance between the light produced on the surface of the water and that which is due to atmospheric phænomena, by designating the former "meteors of the sea." Something of this idea is evident even in the writings of learned men, who endeavoured to explain this phosphorescence solely by physical or chemical causes. Thus Nollet could see in it only a simple modification of electrical phænomena. Bajon, in his memoirs on the History of Cayenne, regards this light as due to the electricity of the waves, deve-

* From the Annales des Sciences Naturelles, vol. liv. 3rd series, as inserted in Silliman's American Journal of Science for March, 1853.

loped by the force of opposing currents or by the prows of vessels. Other authors have attributed it to phosphoric fires, to the burning of bubbles of hydrogen which rise to the surface to explode, &c. The opinion published by Tingry is of a similar nature. This philosopher regards the phosphorescence of the sea as analogous to that which certain bodies, the diamond in particular, present, after having been awhile exposed to the sun. Without entirely setting aside the agency of animals, he attributes the greater part of the phænomenon to a sort of previous imbibition of the sun's rays, which are thrown out again during the night. He thus explains entirely by physical causes the remarkable intensity of this phosphorescence in tropical seas*.

A more rational if not a more correct explanation, at least for many cases, is that which attributes the phosphorescence of the sea to the decomposition of fishes and other marine animals. This opinion was adopted by Commerson in his manuscripts which are deposited in the library of the Muséum.

A passage very much to the point is quoted by Lesson from one of his manuscripts†: "Phosphorescence is owing to a general cause, that of the decomposition of animal substances, especially of whales and seals, which abound in oily matters." Bory de St. Vincent, Oken, and others have adopted the same view. There is certainly great appearance of probability in this explanation; it is sustained by well-known facts, and sufficiently accounts for certain circumstances of the phænomenon. Still, in many cases it is scarcely better founded than the preceding. The same appears to have been the opinion of Newland, and of those who like him have attributed phosphorescence to the spawn of fishes.

But, since the beginning of the last century, careful observations have been made; and various observers have found that a great number of sea animals have the property of directly emitting this light. Since 1805, Viviani, professor of natural history at Genoa, has discovered in the neighbourhood of that city, and described in a work on the subject, fourteen species of phosphorescent animals‡.

Many travellers have noticed the phosphorescent properties of the Medusæ. Spallanzani, by diffusing in milk the mucus from their bodies, rendered the liquid luminous§. Vianelli attributed

* De la phosphorescence des corps, et particulièrement de celle des eaux de la mer (Journal de Physique, t. xlvii.).

† Dict. des Sc. Nat., article Phosphorescence.

‡ Phosphorescentia maris quatuordecim lucescentium animalculorum novis speciebus illustrata. Genuæ, 1807.

§ Voyage en Sicile.

the phosphorescence of the sea to a *Nereis*; Shaw, to certain flexible zoophytes, &c.

French naturalists have not been behind in this movement. In 1764, Rigaut discovered and described in an unmistakeable manner the *Noctiluca* of Suriray; it is to them that he attributes the phosphorescence of the British Channel and Atlantic Ocean. The Abbé Dicquemare, by researches in the harbour of Havre, confirmed the first results, which, forgotten for a time, were again corroborated by the labours of Suriray at the same locality. The learned hydrographical engineer, M. de Tessan, rediscovered the Noctilucæ, or animals very similar, in the seas of the Cape of Good Hope, at False Bay*. M. Rang mentions their presence on the coast of Algiers†. More recently M. Verhaeghe has been led by his investigations at Ostend‡ to the same conclusions as Dicquemare and Suriray.

The assertion of Rigaut was manifestly exaggerated; the Noctilucæ are not alone in producing this phænomenon. The luminous properties of various Medusæ have been established beyond doubt by the testimony of Peron, Macartney, Tilesius, Banks, Forskal, Humboldt, Ehrenberg, Rathke, &c. Peron and Lesueur, Humboldt, and others after them, have described with enthusiasm the magnificent spectacle presented by shoals of Pyrosomas, which in the dark look like streams of fused metal. Henderson ascribed the light of the Gulf of Guinea principally to the Scyllari and to Salpas§. Certain Acalephs, Mollusca, Crustacea, Annelids, Rotatoria, Lumbrici, Turbellariæ, Echinoderms, Zoophytes and Infusoria have been successively pointed out as capable of phosphorescence; and if we do not here go into more detail on this point, it is because the subject has been so fully treated by Ehrenberg. In the work which the illustrious Secretary of the Berlin Academy has devoted to the phosphorescence of the sea, he has enumerated 450 authors who have treated more or less fully of the production of light by organized beings; and to this memoir we refer those readers who are curious to understand thoroughly the history of the question‖. We annex a table, cited almost entire from M. Van Beneden, in which are

* Comptes Rendus de l'Académie des Sciences, 1840. Rapport fait par M. Arago.

† Cited from Gervais, by M. Van Beneden.

‡ Report of M. Van Beneden on the memoir of Dr. Verhaeghe, entitled "Recherches sur la cause de la phosphorescence de la mer dans les parages d'Ostende" (Bulletin de l'Académie Royale de Belgique, t. xiii. par. 2. p. 3. 1846).

§ Cited by M. Van Beneden.

‖ Das Leuchten des Meeres (Abhandl. der Königl. Akademie der Wiss. zu Berlin, 1834).

enumerated the various species of invertebrate animals whose phosphorescence has been established.

Insects.

Lampyris.—L. noctiluca, L. splendidula, L. italica, L. ignita, L. phosphorea, L. nitidula, L. lucida, L. hemiptera, L. japonica.

Elater.—E. noctilucus, E. ignitus, E. phosphoreus, E. lampadion, E. retrospiciens, E. lucidulus, E. lucernula, E. speculator, E. janus, E. pyrophanus, E. luminosus, E. lucens, E. extinctus, E. cucujus, E. lucifer.

Buprestis.—B. ocellata.

Chiroscelis.—C. bifenestrata.

Scarabæus.—S. phosphoricus.

Pausus.—P. sphærocerus.

Fulgor.—F. laternaria, F. serrata, F. pyrrhorhynchus, F. candelaria.

Pyralis.—P. minor.

Achita.—A. gryllotalpa ?

Myriapoda.

Scolopendra.—S. electrica, S. phosphorea, S. morsitans.

Julus.

Crustacea.

Carcinium.—C. opalinum.

Erythrocephalus.—E. macrophthalmus.

Scyllarus.—Species not determined.

Gammarus.—G. pulex.

Cyclops.—C. brevicornis.

Oniscus.—O. fulgens.

Annelida.

Nereis.—N. mucronata, N. noctiluca, N. phosphorans.

Syllis.—S. fulgurans.

Photocharis.—P. cirrhigera.

Polynoe.—P. fulgurans.

Chætopterus.—C. pergamentaceus.

Lumbricus.—L. phosphoreus.

Planaria.—P. retusa.

Mollusca.

Helix.—H. noctiluca.

Pholas.—P. dactylus.

Pyrosoma.—P. atlanticum, P. giganteum.

Phallusia.—P. intestinalis.

Salpa.—S. zonaria, S. Tilesii.

ECHINODERMATA.

ASTERIAS?
OPHIURA.—O. telactes, O. phosphorea.

ACALEPHA.

PELAGIA.—P. phosphorea, P. noctiluca.
OCEANIA.—O. Blumenbachii, O. pileata, O. hemisphærica (Thaumantias), O. lenticula, O. microscopica, O. scintillans.
BEROE.—B. fulgens, B. rufescens.
CYDIPPE.—C. pileus.
MNEMIA.—M. norvegica.

POLYPI.

PENNATULA.—P. phosphorea, P. grisea, P. rubra, P. argentea.
VERETILLUM?
GORGONIA?
SERTULARIA?
ALCYONIA?

INFUSORIA.

CERATIUM.—C. tripos, C. fusus.
PERIDINIUM.—P. Michaelis, P. acuminatum, P. furca.
PROROCENTRUM.—P. micans.
STENTOR?
SYNCHÆTA.—S. baltica.
NOCTILUCA.—N. miliaris.

We believe that the above list is far from complete, at least as regards marine animals. Our own observations enable us to add at least two species of *Polynoë*, one species of *Syllis*, some species of allied genera, and one or two of *Ophiura**.

* In the above list of phosphorescent Crustacea, *Oniscus fulgens* is a *Sapphirina*; and the *Carcinium* probably belongs to the same genus (see Silliman's Journ. [2] ix. 133). *Regulus*, *Euphausia*, and *Cypridina* are other phosphorescent genera, as observed by the writer; and also *Lucifer* according to Thompson (Zool. Researches, p. 58), and *Thysanopoda*, Edw. *Cypridina* is evidently the genus of the species referred to by Reville as observed to be phosphorescent on a voyage to India (Mém. de l'Acad. des Sci., Savans Etrangers, iii. 267, and Thompson's Zool. Res. p. 41).

Scyllarus must be incorrectly added to the list, as there are no oceanic species of the genus. The error is moreover evident from the fact that the reference of the phosphorescent Crustacea to this genus was made before the species were well understood. Captain Tuckey who states the facts, in his Voyage to the Congo, has the words, "with little Crustaceous animals of the *Scyllarus* genus (attached to them [*Salpæ*])," —evidently inconsistent with the genus *Scyllarus*, which includes large species of very different habits. The term was probably meant for *Squilla*, and the species may have been Schizopods of the family Euphausidæ.—J. D. DANA.

II. *On the mode of producing light by Marine Invertebrata.*

Almost all researches undertaken to discover the manner of producing light in animals, have been made on insects, especially the Lampyri and Elaters. Spallanzani, Burmeister, but above all, Macaire*, have published results apparently decisive. These experiments undertaken and varied by Matteucci†, with all the precautions furnished by experimental science at the present day, leave, we think, no room for doubt. In the insect which he examined, the light was produced by an actual slow combustion analogous to that of phosphorus exposed to the air. This light is extinguished in a vacuum and in the irrespirable gases; it reappears by contact with atmospheric air; it is sensibly brightened in pure oxygen; it continues in animals after they are dead, or even cut to pieces. The particular substance from which it emanates may be isolated, and may leave upon the fingers or the dissecting instrument a luminous streak which disappears only on drying; a little dampness even, in certain cases, is sufficient to restore the phosphorescence; finally, the production of this light is accompanied in the living animal, as well as in its dead carcass, by the escape of carbonic acid. Everything concurs then to show that the phosphorescence of insects, and probably of all aërial animals, is owing to a peculiar secretion, whose substance combining slowly with oxygen produces light.

But can this explanation of phosphorescence be applied to invertebrated animals living in water? Such questions immediately arise, but yet have been overlooked by most naturalists. The greater part of the observers from whose works we have cited have been satisfied with knowing that animals produced the phosphorescence of the sea; some have gone a little farther and have attributed this phænomenon to the secretion of a luminous liquid. This opinion appears generally adopted, and traces of it may be seen even in the writings of some naturalists who have not formally stated it. The experiments of Spallanzani and the observations of many travellers seem fully to confirm this view, which is evidently correct in some cases. Dugès, for instance, has decidedly adopted it, and has implied a resemblance between the phosphorescence of the Medusæ and Annelids, &c., and that of the Elaters and Lampyrides‡.

A very different opinion has been set forth by M. Gilbert, an officer of the corps of naval engineers, who, without being aware of the investigations of others on this subject, had seen the *Noctilucæ*, and describes them rather coarsely, but in a manner easily

* Journal de Physique, t. xciii.

† Leçon sur les phénomènes physiques des corps vivants, 8e leçon.

‡ Traité de Physiologie comparée, t. ii. Montpellier, 1838.

recognised. He explains the production of light in these animals by the development of electricity from the surface of their bodies, a development brought out by the action of the waves*. This explanation is evidently untenable even in a merely physical point of view.

Lesson appears to us one of the first, if not the first, who has seen in phosphorescence a phænomenon distinct from the physico-chemical actions which take place in our laboratories, but without explaining himself very fully on this subject. This naturalist regards phosphorescence as due to Crustacea belonging to different genera; he allows that the seat of this light, emitted on irritation or at the time of procreation, resides in glands placed in a variable number on the sides of the thorax. He adds:—"This light should be regarded as a fact established by investigation, as a modification of the laws of life, and as different from the simple sparkling light resulting from the decomposition of animal substances†."

Carus, losing sight of the philosophy which prevails in his works, adopts the opinion that this phænomenon is a property of *primary animal matter*, which is nothing else than the nervous substance, and which representing the solar element in the animal, necessarily appears luminous to the planetary element‡. He, then, as well as Oken, from whom he cites the passage, "regards the jelly of Zoophytes, Medusæ, &c., as the nervous substance in its lowest stage, from which the other substances embraced within it have not been isolated."

M. Bérard, cited by Dugès§, regards the phosphorescence of animals as due to a kind of luminous imbibition, or purely vital effect, analogous to those which result in different bodies from the action of heat, electricity, light, &c.

Dr. Coldstream published in Todd's 'Encyclopædia' a very interesting article on phosphorescence||. After having examined the nature of animal light, the natural or artificial circumstances which influence its appearance or intensity, the points of body in different animals from which it is produced, he sums up all that we have learned from different authors of the phosphorescent organs, and the different theories proposed to explain these phænomena. We quote from this English author some passages from this part of his work.

According to Beccaria, Meyen, &c., the phosphorescence of

* Annales maritimes, 1817.

† Dict. des Sc. Natur., 1826, article Phosphorescence.

‡ Traité élémentaire d'Anatomie comparée, traduit par Jourdan, t. i.

§ Traité de Physiologie comparée, t. ii.

|| The Cyclopædia of Anatomy and Physiology, Part xxii. article Animal Luminousness. 1841.

animals is owing to what they absorb from the rays of the sun, which they throw out again in the dark.

Spallanzani regards phosphorescence as a kind of combustion sustained by the oxygen of the air.

According to Brugnatelli, the light is taken in with the food, and disengaged by particular organs.

Macaire considers the phosphorescent matter as composed of phosphorus and albumen. The variations of intensity apparent in the light arise more or less from the coagulation of the albumen, a coagulation which is increased or diminished at the will of the animal, and permits a more or less rapid combustion.

Tiedemann, Darwin, H. Davy, Heinrich, Treviranus, Burmeister, &c., believe in the secretion of a liquid containing phosphorus, and in the combustion owing to the air introduced by respiration.

Macartney and Todd regard phosphorescence as due to the nervous fluid concentrated and modified by certain organs, so as to appear under the form of light.

The author next proposes his own theory founded on a sort of fusion between the two preceding. With Macartney, he admits that phosphorescence is due to an imponderable agent, and compares it to the production of electricity by certain fishes. But considering the well-known fact of the luminous traces that certain animals leave behind them, he supposes that phosphorus or an analogous substance may very well enter into the composition of the organs which produce the light.

It is plain that Dr. Coldstream, in common with all the authors whom we have cited, believed that phosphorescence should be attributed to but one cause.

This error M. Becquerel* has avoided. After having shown that in the *Lampyris* and other insects phosphorescence is the result of a chemical action at the control of the animal, M. Becquerel relates the observations of Ehrenberg, and admits with him that in certain inferior animals the production of light is owing to a disengagement of electricity. Moreover, he recalls the observations of MM. Quoy and Gaimard, who had seen under the equator, near the island of Rawak, small zoophytes, which while swimming rapidly, drew after them luminous trains. Finally, M. Becquerel, resting on this fact, and on his own observations made in company with M. Breschet, at Venice, in the waters of the Brenta, allows that the phosphorescence of the sea may be owing to an organic substance intimately combined or mingled with the water, analogous to that which covers the herring and other fish when they are phosphorescent.

* Traité de Physique comparée, dans ses rapports avec la Chimie et les Sciences naturelles, t. ii., 1844.

Dr. Coldstream seems not to have known of two memoirs which appeared in Germany, about the same time, and which we have reserved for the close of this history, on account of their peculiar interest.

The first of these works is that of M. Ehrenberg*, and it is incontestably the most complete which has been published on this subject. To all the facts made known by his predecessors, the author adds the result of his own investigations in many seas. At Alexandria he established beyond doubt the fact that the *Spongodium vermiculare*, as also other Algæ regarded as phosphorescent, owe this appearance only to the luminous animalcules adhering to their surface. He describes a new species of *Polynoë* (*P. fulgurans*) found by him in the Baltic, that apparently plays an important part in the phosphorescence of that sea, which also owes its luminous properties to different infusoria. At Christiana and at Heligoland, Ehrenberg observed this phænomenon in many species of Medusæ; at the last locality he met with the *Noctiluca miliaris*, which he calls *Mammaria*. Ehrenberg describes also the very remarkable mode of phosphorescence which appeared in a Nereid, the *Photocharis cirrhigera*. In that Annelid, the light proceeds from two thick and fleshy cirri belonging to the dorsal branch of the feet. The author observed sparks, at first isolated, invade the cirri by degrees, until they became luminous in their whole extent; then the phosphorescence spread through the whole back, until the animal looked like a thread of burning sulphur. The mucus secreted by the *Photocharis* left on the fingers a luminous trace. In the *Polynoë fulgurans*, Ehrenberg regards two large rough bodies, resembling ovaries, as charged with producing the light. In the *Cydippe pileus* and in the *Oceania pileata*, he found that the light starts from the centre, that is, in the neighbourhood of the reproducing organs. In the *Oceania hemisphærica*, a species whose diameter is more than an inch, Ehrenberg saw the sparks from a chaplet around the border; these correspond to the large cirri or to the organs alternating with them.

Ehrenberg sums up in the following manner the important results of his labours:—

1st. The phosphorescence of the sea appears to be owing solely to organized beings.

2nd. A very great number of organic and inorganic bodies shine in the water and out of the water in different ways.

3rd. There is also a light from organized bodies, which is probably owing to vital action.

4th. The active organic light shows itself frequently under the form of a simple flash, repeated from time to time, sponta-

* *Loc. cit.*

neous or provoked. Often also it appears under the form of repeated sparks, following each other in quick succession, under the influence of the will, and very similar to electric sparks. Often, but not always, there is formed by this production of sparks, a mucilaginous humour, gelatinous or aqueous, which is diffused around in great abundance, and is evidently placed in a secondary or passive state of phosphorescence, which continues a long time without requiring any new influence from the organic being, and even lasts after that has been divided or destroyed.

A light which to the naked eye appears uniform and tranquil, shows itself scintillating under the microscope.

5th. The viscous humour which envelopes and penetrates the ovaries seems to be especially susceptible of acquiring this communicated light, which is constantly reinforced by friction, and reappears even when it seems to have ceased.

May not the light emitted by living fishes, by Actinias, and by many other animals covered with mucosity, be sometimes merely communicated?

6th. The relations which exist between the production of light and the sexual functions are evident in the Coleoptera, although the connexion of the small luminous sacs with the reproductive organs may remain concealed. With many marine hermaphrodite animals, phosphorescence appears to be a means of defence and protection, analogous to those of another kind which exist in the *Brachinus crepitans*, the cuttle-fish, the frog, or to the discharges of the torpedo. Whatever it may be, the air and the sea have their phosphorescence.

7th. As yet it is only among the Annelids, and of them only in the *Photocharis*, that a peculiar phosphorescent organ has been discovered; it is external, tufted, frequently giving out light, similar to a thick cirrus, showing a largely cellular structure, and formed within of a mucilaginous substance. The expanded base of the marginal cirri in the Thaumantias (Acalephs) may be regarded as phosphorescent organs, of an unusual kind. The ovaries are more probably luminous, passively and in a secondary manner, although their minuteness and transparency have prevented our ascertaining whether the organs of phosphorescence are placed near them, as for instance in the *Polynoë* and *Pyrosoma*.

8th. The production of light is evidently a vital act very similar to the development of electricity, an act which being completely individual, becomes more feeble and ceases on too frequent repetition, which reappears after a short interval of repose, to the production of which absolute integrity of the organism is not necessary, but which sometimes manifests direct connexions only with the nervous system.

The memoir of Meyen is less extended, but it contains some important facts*. The author admits three kinds of phosphorescence:—1. The phænomenon is owing to a mucosity diffused in water. In that case the water seen in the day has a uniform tint of bluish white. It is often observed in tropical ports, but rarely out on the open sea. This mode of phosphorescence may be produced artificially by washing or by crushing certain Mollusks and Acalephs either in sea-water or in fresh. 2. Phosphorescence results from the presence of certain living animals, endowed with a luminous mucus. This continues even after the death of the animal; it arises from a superficial oxidation of the mucous coating, and it can be reproduced after it seems extinct by passing the finger over the animal. The animals which owe their luminous property to a secretion are, according to the author, Infusoria, Rotifera, Biphoræ, Medusæ, Asterias, Cuttle-fish, Sertulariæ, Pennatulæ, Planariæ, Crustacea and Annelids. 3. The third cause of phosphorescence is in some animals from the presence of one or more special organs. Of this number are the *Pyrosoma*, and especially *P. Atlantica*, whose light, of a greenish blue, is very brilliant. Each individual carries behind its mouth a soft opake substance, of a reddish brown colour. This body is slightly conical, and under the microscope thirty or forty red points may be seen; it is this substance which produces the light.

III. *Observations.*

It is apparent from the foregoing statements, that the great majority of naturalists, whatever explanation they have given of the phosphorescent phænomena, have applied that explanation indiscriminately to all cases. Meyen himself, while admitting three kinds of phosphorescence, nowhere expresses the idea that the production of light arises from causes essentially different.

It is in this point, I believe, that the writings of these learned men are deficient. In a note published in 1843†, I endeavoured to establish a different opinion, and to show, that under the general name of phosphorescence, phænomena essentially distinct have been confounded, and which have really nothing in common but the production of light. We have already shown that such is also the opinion of M. Becquerel. After having reviewed all that my predecessors have written on the subject, after having made new experiments and new observations, I am more than ever persuaded that it is really so. Without speaking of the phos-

* Beiträge zur Zoologie, von F. J. F. Meyen, fünfte Abhandlung. Ueber das Leuchten des Meeres (Nov. Act. Nat. Cur. t. xvi. Suppl. 1834).

† Note sur un nouveau mode de Phosphorescence observé chez quelques Annélides et Ophiures (Ann. des Sc. Nat., 2e série, t. xix. p. 183).

phorescence arising from animal decomposition, nor of that which results from mucus in a state of solution, I believe that light is produced in living animals in two ways:—

1st. By the secretion of a peculiar substance exuding either from the entire body or from a special organ. It is probable that in this first mode of phosphorescence the light always arises from a slow combustion. The fact is proved as regards insects; but direct experiments are necessary before the same certainty can exist as to marine Invertebrata, Annelids, Mollusks or Radiata.

2nd. By a vital action, whence results the production of a pure light independent of all material secretion. I had arrived at this result at the time of the publication of my first note. My observations accord entirely with those that Ehrenberg made before me; yet doubts have been thrown out on the legitimacy of conclusions which we had both considered warranted by facts furnished by observation alone. I hope that the experiments which form the subject of the latter part of this memoir will reply to all these objections.

When I published my first note, I was informed of Ehrenberg's results only through a conversation with Humboldt. I have since consulted his memoir, and find that on some points we agree entirely, while we differ on others.

With Ehrenberg I had learned to see in the phosphorescence of the Annelids and Ophiura which I have examined an action essentially vital; but I cannot regard this action as strictly confined either to the organs or the functions of generation, as the learned naturalist of Berlin considers it. I find, it is true, in reviewing my notes, that one of the *Polynoë* which best exhibited the phosphorescence was filled with zoosperms in full maturity, but many other Annelids among those which I have studied were not in that state. Even in admitting that the light may be most brilliant at the period of gestation, I should regard that fact as merely a coincidence arising from the increase of vital energy which is thus very plainly manifested by all these animals. Besides, in the Ophiura, the independence of the light and the generative organs is very evident, since the sparks are seen only along the arms, and the reproductive organs are enclosed in the body, whose walls are very thick.

M. Ehrenberg first made known the fact, that the phosphorescence of Annelids, &c., always results from a combination of microscopic sparks. Here my observations accord entirely with his. We have compared these little flashes to those which are produced from a '*tableau fulminant*' which has been charged from an electrical machine.

But M. Ehrenberg has described in the *Polynoë* a special organ for producing this light. Here we differ. In the *Polynoë*, as

in the Syllæ and the other little Nereids which have been the subject of my investigations, I have never perceived any peculiar organ from which the light appeared to emanate. The muscles alone, and particularly the muscles of the feet, have appeared to me to present this phænomenon. I have seen, moreover, some Syllæ for instance shine through the whole extent of their bodies; and in this case the comparison to a thread of burning sulphur is striking and just. This is the appearance to the naked eye; but under the magnifying glass this thread is divided into a double range of luminous points corresponding to the feet.

I am far from denying that certain animals may have organs charged with secreting light, as certain fishes possess those for secreting electricity; but up to this time I have never seen that sparkling light show itself except in the muscles and at the moment of contraction. There may undoubtedly exist on this point reasonable uncertainty with regard to those Annelids whose foot-muscles are lodged in the abdomen; but this cannot be true with respect to the *Ophiura*, and nothing is easier than to prove this even to the unaided vision, as in the latter the phosphorescence appears along the arm, and only during movement. Moreover, the details which will be given beyond of the phosphorescence of the *Noctilucæ* will show plainly, I believe, that these animals have no special organ for producing the light.

Finally, the *Photocharis* observed by Ehrenberg secreted a liquid which left luminous traces on the objects which came in contact with it. This peculiarity I have also met with in one of my Annelids; but generally in the latter, and especially also in the *Ophiura*, the light was owing entirely to the scintillations, and disappeared with them. It is, however, easy to believe that the modes of phosphorescence which we have admitted may coexist in the same animal.

[To be continued.]

VII.—*On the Structure of the Leaves of Palms.* By M. A. Trécul*.

Notwithstanding the important investigations of Von Mohl and Mirbel, there still remains considerable uncertainty upon the structure of the leaf in the Palms. For instance, what is the ligula of the flabelliform leaves of many of these plants? Are their lobes the natural divisions of the leaf, or only accidental rents of its substances? Both these opinions are advanced. How is the plaited limb of these leaves formed? Are the pin-

* From the Comptes Rendus, May 16, 1853, p. 857.

nules of the pinnate leaves formed like those of dicotyledonous plants? I do not hesitate to say at once, that the phænomenon is very different, and that the origin of the ligula is by no means that which has been supposed by very celebrated anatomists.

In examining palms with pinnate leaves, one of the leaves of which is just expanding, it will be seen that the old leaves have the pinnules distant from each other on the rachis and free at their extremities, whilst that which is just emerging from its enclosing sheath presents a very singular appearance. The elongation of the rachis removes the pinnules from one another, but they are all joined together at the apex; sometimes they are united in this manner by a cellulo-fibrous thread which even contains vessels (I have seen spiral and streaked vessels in the threads of *Phœnix sylvestris*), and which extends from the base of the limb to its apex. The sheath of this leaf encloses another, all the leaflets of which are frequently so compressed together, that they appear to form a single piece without any parts distinguishable by the naked eye; in other cases in which the compression is less, all the parts of the leaf are apparent.

What is the mode of formation of these leaflets, so singularly attached to one another?

In examining a *Chamædorea Martiana* we find that in this leaf in which all the parts are pressed together, the upper leaflets are much longer than the lower ones. In a leaf of 16 centimetres (about $6\frac{1}{2}$ inches) in length, the upper pinnules were 13 centimetres (about $5\frac{1}{4}$ inches) long, whilst the lower were only 3 millimetres (about $\frac{1}{8}$ inch), and this disproportion may increase when the apex of the leaf becomes extended. In this leaf there were thirteen pinnules on each side of a rachis of 2 centimetres (about $\frac{1}{5}$ inch) in length, and the two rows being placed on the inner surface, the back of the rachis only could be seen.

A few millimetres below the lower leaflets is the opening of the sheath. If this be removed, a very remarkable conical body is exposed. Extracted from a leaf of 16 centimetres in length, it measured $3\frac{1}{2}$ millimetres. This is also a leaf, which when viewed from behind presents an entire surface, but in front is divided into two portions; the lower portion is cylindrical and notched at the apex at the opening of the sheath; the upper portion, which is conical, is divided longitudinally on the inner surface into two rolls, which diverge towards the base and become attenuated towards the apex. These are the two rows of leaflets in course of formation. Each roll is transversely striated on the sides, and the striæ or furrows of one side of the roll alternating with those of the other side of the same render the longitudinal ridges sinuous.

By opening the sheath of this leaf I obtained another which

was about $1\frac{1}{4}$ millimetre in length. Its two rolls (or series of leaflets), a little less advanced than those of the preceding leaf, were comparatively more divergent at the base. From the sheath of this leaf issued the apex of a still younger one not more than $\frac{2}{3}$ millimetre in length. Its lateral rolls were only marked with faint striæ or transverse depressions towards the middle, and its sheath also gave exit to the tip of another leaf. This latter was not more than $\frac{1}{4}$ millimetre in length; its sheath, which was short and thick, had a broad rounded opening about the middle of the leaf, through which the naked apex of the stalk could be seen. This sheath was surmounted by the nascent rachis, but this presented no trace of leaflets. It was broad and depressed in its median portion; and there was on each side a longitudinal swelling of so little prominence that it required considerable attention to perceive it at all. These swellings are the origin of the two rows of leaflets.

Thus a leaf of *Chamædorea Martiana* commences with a simple circular cushion at the apex of the stalk. This cushion or rudimentary sheath is produced obliquely into a prominence, which is depressed on its inner surface. This becoming elongated into a cone produces a longitudinal roll on each of its margins. These two rolls or cushions, which are more inflated near the sheath, where however they terminate in a short point, become more and more contracted towards the apex of the rachis. Originally they are smooth, but during their growth scarcely sensible undulations are produced on each side of them (first on the inner side); of these the first appear a little way from the base of each roll, and they afterwards increase in number and attain the base and apex of the rachis.

Whilst all the parts of the leaf continue growing, these undulations, increasing in depth, become furrows which penetrate by degrees into the interior of the roll, at length arriving at the opposite side on the outer surface so as to produce a rupture; but the furrows which penetrate from the outer surface towards the inner cease advancing before reaching the latter, so that scission takes place only at the sides of the outer surface. In this manner are produced as many leaflets plaited in the direction of their median nervure as there were ribs on the inner surface; but the separation of the leaflets is not completed in this manner through their entire length; it stops near the apex, which remains united to the side of the leaflet placed above it. When the leaf emerges from its sheath and the leaflet expands, this point of attachment becomes broken and the apices of the leaflets are set free. The union of the leaflets is not the same throughout the palms; in *Phœnix sylvestris, Acrocomia sclerocarpa,* &c., the points of the pinnules are attached to a cellulo-

fibrous thread which runs along the whole length of the leaf, and retains the leaflets in union for some time after their expansion. This filament and the brown pellicles which cover the leaves at this period have a similar origin. They arise from an envelope, within which the leaflets are organized, and which becomes dried up and falls in small brown flakes. The existence of this envelope may be recognized in the very young leaves, even at the period when the furrows (as in the *Chamædorea*) begin to make their appearance. The leaflets then appear to be formed in a substance of a gelatinous appearance, which is the origin of this pellicle.

The leaflets of all palms are not plaited in the same direction; some, as *Chamædorea Martiana, Ceroxylon andicola, Areca rubra, Arenga saccharifera*, &c., have them folded on the lower surface; others, in which the scission is carried to the ridges of the inner surface and not to those of the outer, have the leaflets folded on the inner surface, as *Phœnix dactylifera, sylvestris, Fulchiron senegalensis*, &c. There are other palms of which the leaflets are broader and contain several folds of the primary lamina. It appears to me that very good characters may be derived from the plication of the leaflets.

The limb of the simple leaf of *Geonoma baculum* is somewhat differently developed; the rachis emits a lanceolate limb, widest at the base; this becomes plaited first at this basal portion, the folds extend in proportion to the growth of the leaf, and the upper extremity becomes cleft to form the two terminal lobes.

In *Chamærops humilis*, as in *Chamædorea* and plants with sheathing leaves, all the leaves are enclosed by their sheaths. In a leaf of 1 millimetre the sheath was equal to the half of the length of the leaf; it was opposite to an inflated portion covered with hairs, which is only the rudimentary limb. I removed all these hairs and with them a pellicle which clothed this part of the leaf. In this manner I arrived at a rounded surface, divided longitudinally into parallel ribs on the anterior and posterior surfaces of the limb. The surface being convex, the ribs are shorter on the sides than towards the middle. They are inserted on a nearly horizontal plane and rise parallel in growing. Each rib of the outer surface corresponds to the median nervure of a lobe of the leaf.

As long as the leaf remains enclosed in the sheath, all its parts consist of a very delicate tissue, but as soon as its apex reaches the air and light it becomes green, grows rapidly, and acquires consistence; the limb is often hard and coriaceous and contains much woody matter, whilst the base of the petiole, which is enclosed in the sheath, is still of extreme fragility. It is also this lower portion which continues growing longest. Thus the limb

of the leaf of *Chamærops humilis* is found under a pellicle clothed with hairs, which is torn at the junction of the petiole by the growth of the limb; and it is the base of the pellicle which gives rise to the organ which has been called the *ligula* of the flabelliform leaves of certain palms, and to the cicatrix which is observed round the extremity of the petiole.

PROCEEDINGS OF LEARNED SOCIETIES.

LINNÆAN SOCIETY.

June 1, 1852.—R. Brown, Esq., President, in the Chair.

Read a memoir "On *Acradenia*, a new genus of *Diosmeæ*." By Richard Kippist, Esq., Libr. L.S.

The new genus described was one of a highly interesting collection formed in the neighbourhood of Macquarrie Harbour, Van Diemen's Land, by Mr. Joseph Milligan, and by him, through the late lamented Mr. Bicheno, presented to the Society. It belongs to the natural order *Diosmeæ*, tribe *Boronieæ*, and in habit most nearly approaches *Zieria*, to the larger-leaved species of which it bears at first sight considerable resemblance. From this genus, however, as well as from *Melicope*, *Boronia*, and *Cyanothamnus*, from *Eriostemon*, *Crowea*, and *Philotheca*, and from *Geleznowia*, Turcz., it differs in various characters which are more particularly indicated; and it is distinguished from them all by the structure of its ovaries, which adhere closely together and are everywhere clothed with a dense tomentose covering; except that each bears, at its upper external angle, a naked sessile tubercle or gland, large enough to be readily observed with the naked eye, a character which Mr. Kippist has been unable to discover in any closely allied genus, and which has suggested the generic name. He is unable to speak positively as to the precise nature of these glandular bodies, or to say whether any exudation proceeds from them: when examined under the microscope they appear to be perforated by a tube, widening below, and communicating with the internal cavity of the carpel; and from their exact correspondence in position, they are probably analogous to the cornute appendages which crown the ovaries of some species of *Phebalium*, in which genus they are occasionally developed into subulate or nearly cylindrical horns.

ACRADENIA, *Kipp.*

Calyx 5-partitus. *Petala* 5, hypogyna, calyce multò longiora, æstivatione imbricata, ovato-elliptica, undique velutina. *Stamina* 10, hypogyna, petalis sublongiora, alterna paullò breviora; *filamenta* libera, subulata, glabra; *antheræ* introrsæ, glabræ, biloculares, rimâ longitudinali dehiscentes, apice inappendiculatæ. *Ovaria* 5, gynophoro disciformi margine sinuato incidentia, 1-locularia, villosissima; singula apice glandulâ majusculâ sessili instructa. *Ovula* in loculis gemina, suturæ ventrali collateraliter inserta, pendula. *Styli* in unicum glabrum coaliti.

Stigma subcapitellatum. *Capsula* 5- (vel abortu 1–3-) cocca; *cocci* basi subcohærentes, sepalis persistentibus pluries longiores, subquadrati, paulo compressi, basi rotundati, apice abrupte truncati et angulo externo brevè cornuti, coriacei vel sublignosi, dorso carinati, transversim rugosi, extus glabriusculi, intus sulcati, glabri, *endocarpio* haud secedente. *Semina* ....?—Frutex *Tasmanicus, ramosissimus*; foliis *oppositis, exstipulatis, petiolatis,* 3-*foliatis, foliolis coriaceis, lanceolatis, serratis, suprà tuberculatis*; pedunculis *terminalibus, trichotomè cymosis, multifloris*; floribus *albis*.

Acradenia Frankliniæ, *Kipp.*

Zieria Frankliniæ, *Milligan, MSS.*

Hab. ad margines sylvæ densæ prope Portum "Macquarie" dictum Insulæ "Van Diemen," ubi floribus expansis legit Dom. Jos. *Milligan* mense Decembri 1846, et iterùm Martii 1847.

The close resemblance to *Zieria* in habit had originally suggested to Mr. Kippist the specific name of "*Zierioides*," but Mr. Brown having kindly communicated to him a specimen gathered by Mr. Milligan on the Franklin River in April 1842, with a ticket attached, from which it appears that Mr. Milligan had proposed to name the plant "*Zieria Franklinia*" (after Lady Franklin), he has adopted with much pleasure that specific name. On the same ticket Mr. Milligan describes the plant as handsome and fragrant; but this, as he at that time saw no flowers, Mr. Kippist presumes can only be intended to apply to the leaves, which, as in the majority of the *Diosmeæ*, are copiously furnished with pellucid dots, reservoirs of essential oil, and exhaling probably the peculiar odour which characterizes the family.

The plant having recently flowered at Kew, he was enabled by the kindness of Sir Wm. Hooker to examine the flowers in a living state, but he regrets to hear that it is not likely at present to ripen its fruit at Kew, where Mr. Smith states that it was first introduced in 1845 in a case sent by Dr. M'William from Norfolk Island; a locality, however, in which it is scarcely possible that it should be indigenous.

The same collection from which the *Acradenia* was obtained, included a number of highly interesting plants, quite new to the Society's herbarium. Among the most striking were several alpine *Umbelliferæ*, principally from Mt. Sorrel, of very singular habit, one or two of which have been recently figured by Sir Wm. Hooker in his 'Icones,' from specimens forwarded by Mr. Milligan or his fellow-labourer Mr. Gunn: others appear to be still undescribed. Dr. Meisner found among them a few new *Proteaceæ*, and a most remarkable dichotomous *Pimelea*, with densely silky imbricated leaves, which he proposes to call after its discoverer. It contained, moreover, a number of fine *Epacrideæ*; among them a splendid species of *Dracophyllum* (*D. Milligani*, Hook.), remarkable as being the first instance of the occurrence of that genus in Van Diemen's Land, and a new genus of *Hæmadoraceæ*, with large handsome flowers and equitant leaves, recently described by Sir Wm. Hooker under the name of *Hewardia tasmanica*.

Read further "Descriptions of two new Swan River *Papilionaceæ*." By Thomas Moore, Esq., F.L.S.

The characters of these species, which have recently flowered for the first time in English gardens, are as follows:—

Gastrolobium pyramidale, ramulis foliis stipulis pedunculis bracteis calycibusque densè tomentosis, stipulis longis setaceis recurvis, foliis petiolatis 3-nis ovali obtusis v. rotundatis mucronatis suprà demùm glabris, racemis axillaribus densè capitatis, pedunculis foliis paullò brevioribus, bracteis trifidis: superioribus obovatis mucronatis, calyce campanulato; dentibus superioribus lateralibusque obliquis, pedicellis calyce brevioribus, ovario subsessili villoso.

Hab. ad fl. Cygnorum N. Hollandiæ, *Drummond*, ser. 5. no. 54.

Chorozema nervosum, ramulis pubescentibus, foliis latè cordatis rigidè cuspidatis crassè marginatis integris utrinque conspicuè venosis glabris undulatis subcarinatis, racemis paucifloris axillaribus terminalibusve, pedicellis supra medium bibracteolatis calyce brevioribus.

Hab. ad fl. Cygnorum N. Hollandiæ, *Drummond*, ser. 5. no. 23.

Both plants were obtained by Mr. Moore from the Nursery of Messrs. Henderson in the Edgware-road, where they had been raised from Mr. Drummond's seeds.

November 16, 1852.—N. Wallich, Esq., M.D., Vice-President, in the Chair.

Read Mr. Henfrey's memoir "On the Development of Ferns from their Spores."

The author commences his paper by referring to the remarkable discoveries published by Count Leszczyi-Suminski in 1848. and the observations to which they have subsequently led on the part of others; which appear to necessitate important changes in our general views of the reproduction of plants. He finds, however, that the results of some of these later observations differ in many respects not only from those of Suminski, but also among themselves; and that opinions are divided both as to the actuality of the most important fact of all, viz. the process of impregnation, and as to the period and circumstances of its occurrence. Under these circumstances he has thought he would be performing a useful task in subjecting the question to minute investigation, in the course of which he has carefully traced the development entirely through its course from the spore to the young leafy plant, applying every available means to clear up the anatomical conditions in each stage of the progress. The drawings which accompany the memoir were nearly all made by means of the camera lucida eye-piece, so that they represent preparations actually seen.

The subject is treated of under three heads; the first section containing the author's own observations; the second, a critical examination of those of preceding authors; and the third, a few remarks on the general bearing of the results upon vegetable physiology.

Under the first head, Mr. Henfrey describes first the prothallium, and its mode of growth, enlargement and decay; secondly, the antheridia, with their sperm-cells and spermatozoids; thirdly, the

archegonia, with their papillæ and embryo-sacs; and fourthly, he gives his own view of the development of the embryo. On all these points he enters into much detail, tracing the several stages of the process with great minuteness. In his criticism of previous observations, he passes in review the facts and opinions stated by Nägeli, Suminski, Wigand, Thuret, Hofmeister, Schacht, Mettenius, Von Mercklin, and Hofmeister again; and indicates the points in which they severally differ from each other, and also those in which he himself either coincides with or differs from each of them. The memoir is so completely one of detail, that under these two principal divisions it would be difficult to give a sufficiently clear abstract without running to too great a length; and this is the less necessary as the memoir itself will immediately appear in full in the Society's 'Transactions.'

Under the head of "Development of the embryo" the author gives the following statement of his opinion on the question of impregnation, and the mode in which it is effected:—"My opinion with regard to the fertilization is, that the operation is effected by the contact of one or more *spermatozoids* with the mucilaginous filament contained in or hanging from the mouth of the canal of the *archegonium*. I have seen the *spermatozoids* swimming in numbers around the mouths of *archegonia*, but never detected one inside, and I do not see any good reason for supposing such a process necessary. The pollen-tube of flowering plants only comes in contact with the outside of the embryo-sac, and the influence is sometimes communicated through a long suspensor; and there does not seem to be any sufficient objection to the supposition, that the contact of the *spermatozoid* with the filament of mucilage which lies in the canal of the *archegonium*, suffices to convey the necessary stimulus. I imagine this stimulus resides in the mucilaginous fluid in which the *spermatozoid* is bathed in the *sperm-cell*, and which, adhering to this, is conveyed to the mucilage (protoplasm) of the *germinal vesicle*, just as the contents of the pollen-grain become combined with the protoplasm of the germinal vesicle in flowering plants. The nature of the process is clearly a problem beyond the reach of science, but it seems to me a necessary induction from the facts in the Phanerogamia, that the phænomena result there from the material union of two fluids, and I hence conclude that this is the case here. The comparatively few cases of successful impregnation among these *prothallia*, so many of which prove sterile, may perhaps be accounted for by the peculiar conjunction of circumstances required to bring a sufficient amount of the fertilizing fluid, by means of the *spermatozoids*, to the *germinal vesicle*, at the precise epoch required."

His general "conclusions" are as follows:—"In summing up all these statements it becomes evident that the balance of evidence is in favour of the existence of sexual organs, and of a process of impregnation, giving rise to a new individual, as asserted by Suminski, although under conditions somewhat different from those described by that author. Only two of the observers who have re-

peated his investigations throw doubt upon these points, namely Wigand and Schacht; the statements of the former as to matters of fact are far from sufficient to bear out the mass of argument he has built upon them against the existence of sexes; in fact, his observations were so imperfect that he described the two parts of the *archegonium*, the *papilla* and the enlarged *embryo-sac*, as distinct structures; while he never traced the origin of the new plant at all. His observations may therefore be safely passed over. Schacht's are more complete, but he again only *argues* against the probability of a sexual conjunction, with the preconceived notion that this must be analogous to what he erroneously believes to be the conditions in the Phanerogamia; while his observations furnish facts which greatly support the probability of an impregnation by the *spermatozoids*; the difficulties he suggests being of little weight in comparison with those of accounting for the existence of all the peculiar structures by any other hypothesis. The opinions of all the rest are in favour of the impregnation (Thuret does not treat of the *archegonia*), and the differences between them, except in the case of Suminski, are unimportant in a physiological point of view, merely presenting questions of anatomical and morphological interest. And since Suminski's description of the mode of origin of the embryo would be altogether at variance with what exists, not only in other plants, but also in animals, and is opposed to the observations of all the rest of us (except the doubtful support given by Von Mercklin), I cannot but repeat my belief that he was led from the facts by his imagination being preoccupied by Schleiden's doctrine of the impregnation of the Phanerogamia."

January 18, 1853.—R. Brown, Esq., President, in the Chair.

Read a paper "On the Habits and Structure of the Great Bustard (*Otis tarda*, L.)." By William Yarrell, Esq., V.P. and Treas. L.S.

The particulars relating to the habits of the Bustard are derived from the communications of several friends, who have had opportunities of observing it both in England and elsewhere. The first notice is from C. A. Nicholson, Esq., of Balrath Kells, in the county of Meath, and furnishes remarks on the habits of the bird as observed by him in the neighbourhood of Seville, where it appears to be extremely abundant, the males beginning to arrive in the cultivated country at the beginning of February in flocks varying (according to Mr. Nicholson's observations) from seven to fifty-three; the old birds always associating together, and those of a year old, which are much smaller, never mixing with them: the young birds have neither beard nor pouch. The females do not arrive till the beginning of April, and come singly or at most in pairs; the flocks of males then break up and are met with in parties of three or four, or even singly, spreading their tails on a fine day like Turkey-cocks, drooping their wings and expanding their pouches. The sexes appear to live quite separate. In May the cocks entirely disappear from the cultivated lands, retiring to the extensive grass marshes on the banks of the

Guadalquivir, and leaving the hens behind them. The young are hatched in the corn-plains about Seville, and are able to take care of themselves when the corn is cut in July, after which the young birds and hens follow the cocks to the marshes. The birds are very difficult to shoot: the heaviest shot by Mr. Nicholson weighed 28 pounds; and the largest measured 7 feet 3 inches from tip to tip of wing. Those of a year old weigh from 8 to 10 pounds, and are much the best eating. Their stomachs were found crammed with barley, both leaves and ears, with the leaves of a large-leaved green weed and with a kind of beetle. When flushed they generally fly for two or more miles, and sometimes at least 100 yards high. They never try to run, and Mr. Nicholson cannot imagine greyhounds being able to catch bustards, as they are reported to have done.

Mr. John Wolley, jun., states that he had never seen the Great Bustard, or received its eggs, from the neighbourhood of Tangier. While ascending the Guadalquivir, about the month of September, he saw several flocks of four or five birds each on the level plains which extend along the banks of that river, walking apparently in file, some with their heads down. They did not appear to be timid, or very cautious; but once, as the boat came suddenly round a corner, several of them rose together, springing hastily to the height of 40 or 50 feet, and then turning suddenly and somewhat clumsily, after a few more rapid strokes, sailed along with the arched form of wings so general in game birds.

Mr. Yarrell's next notice is derived from a letter in the possession of John Britton, Esq., giving an account of two bustards seen on Salisbury Plain in the summer of 1801, within a fortnight of each other, both of which attacked mounted horsemen, and one of which was captured and kept for some time by Mr. J. Bartley of Tilstead, by whom it was eventually sold to Lord Temple. The letter gives numerous details of the habits of this bird from the information of Mr. Bartley.

J. H. Gurney, Esq., of Norwich, states in a letter to Mr. Yarrell that, as far as he can learn, the last bustard killed in Norfolk was a female, which was shot at Lexham, near Swaffham, towards the end of the year 1838. The small flock of which this was one had for several years consisted of females only, the eggs of which were frequently picked up, having been dropped about at random in consequence of the absence of male birds, the latter having become extinct at an earlier date. Fredk. J. Nash, Esq., of Bishop's Stortford, has several times informed Mr. Yarrell that, when taking the field as a young sportsman, he once saw nine flights of bustards in one day not far from Thetford in Norfolk. And Gilbert White of Selborne mentions in his Diary, under date of November 17th, 1782, that being at a lone farm-house between Whorwell and Winchester, the carter told him that about twelve years before, he had seen a flock of eighteen bustards at one time on that farm. Three instances only of the appearance of the bustard in England have been noticed by Mr. Yarrell since the publication of the second edition of his 'History of British Birds;' one, a female, recorded by G. R. Waterhouse,

Esq., of the British Museum, as occurring to him in August 1849 on Salisbury Plain; a second, also a female, shot at Lydd in Romney Marsh in January 1850, and now in the possession of Dr. Plomley, F.L.S.; and the third shot on the 31st of December, 1851, in Devonshire, and now in the possession of J. G. Newton, Esq., of Millaton Bridestow.

Mr. Yarrell proceeds to state that he had long wished to have an opportunity of examining the body of a male bustard for the purpose of inspecting the gular pouch described by Daines Barrington in his 'Miscellanies,' 1781, and by Edwards in his 'Gleanings of Natural History,' 1811, and thence copied both by Bewick and himself; but no opportunity for so doing occurred until recently. About four years ago the Zoological Society obtained from Germany six or seven young bustards, and one of these (a male) died within a year. The body was examined by Mr. Mitchell and himself, and no gular pouch was found, but this was then attributed to the youth of the bird. In December last another male of this flock, believed to be four years old, died at the Zoological Gardens, and was also examined by Mr. Yarrell. The neck was carefully dissected; but there was no opening under the tongue, and he entirely failed in various attempts to distend any part of the membranes either by fluid or by air. Thus disappointed in his expectation of finding what had been so minutely described, Mr. Yarrell turned to the translation of the anatomical descriptions of the animals dissected by the Royal Academy of Sciences at Paris at the end of the seventeenth century, and found the results of the dissection of six male bustards there given to correspond entirely with his own observations. He found also that Cuvier in his 'Leçons d'Anatomie Comparée,' refers to no peculiarity in the neck of the male bustard. Professor Owen also entirely confirmed the fact of the absence of any gular pouch by his own dissection of a full-grown bustard made with the view of obtaining a preparation of that supposed structure for the Museum of the College of Surgeons. Mr. Yarrell is therefore disposed to consider that there must have been some mistake on the part of the writers quoted as to the species of bird in which that pouch was observed.

February 1, 1853.—R. Brown, Esq., President, in the Chair.

Read a paper "On Venation as a generic character in Ferns; with Observations on the genera *Hewardia*, J. Smith, and *Cionidium*, Moore." By Thomas Moore, Esq., F.L.S., Curator of the Botanic Garden, Chelsea.

The object proposed by the author is to inquire—1st, into the general importance of modifications of the vascular structure of the fronds in distinguishing the genera of Ferns; and 2ndly, into their relative value in the cases instanced. He begins by referring to the numerous authors by whom the venation has been turned to account in the formation of genera or subgenera, and in particular to the observation of Mr. Brown, that "for subdivision, the most obvious as well as the most advantageous source of character seems to be the

modifications of the vascular structure, or the various ramifications of the bundles of vessels or veins of the frond, combined with the relation of the sori to their trunks or branches." He notices an instance in which Sir William Hooker has given generic importance to this character of venation alone, viz. in *Dictyoxiphium*; while in *Schizoloma* he regards the venation as only of subgeneric value; and he treats it as a mere question of words, to be decided by convenience, whether or not this character should be generically employed. In the case for instance in reference to which Mr. Brown's remarks were made, *Polypodium* (*Dipteris*) *Horsfieldii*, it seems to him, as a matter of convenience, a much simpler and more easily comprehensible idea, to regard *Dipteris* as a group of ferns with round naked sori, dichotomous primary veins and reticulated venules, than to have to recognize in *Polypodium* (a genus of ferns having round naked sori) an included group called *Dipteris*, in which the primary veins are dichotomous and the secondary reticulated. In most cases, indeed, he regards subgenera as at the best but cumbrous contrivances.

Looking at the question of venation, as illustrated in the great and universally adopted natural divisions of flowering plants, he thinks its generic importance in ferns rests on better grounds than convenience alone. In the case of flowering plants the presence of complete floral organs affords the necessary diversity for generic distinction; but as an equivalent to these we have in ferns nothing more than certain naked or covered aggregations of spore-cases, which in the great bulk of the species scarcely afford any differential characters, or such only as are microscopic, and therefore not to be resorted to until all more obvious features are exhausted. But peculiarities in the venation of ferns are for the most part associated with peculiarities of habit; and since it appears quite justifiable to employ other characters than those derived from the fructification in distinguishing generically such groups as the ferns, in which the fructification affords comparatively so little variety, what is there so constant and unvarying, and at the same time affording such diversities, as the peculiarities in the development of the vascular structure? Experience, moreover, attests this character of venation as one to be relied on with perfect confidence, because (with very insignificant exceptions) whatever modification of vascular structure is met with in a particular species, that and no other is found in that species. The author concludes, therefore, that without lowering the importance of the fructification of ferns in distinguishing generic groups, the modifications of venation are properly as well as conveniently admitted to share in the same office.

Passing to the question, whether a reticulated venation is in itself a sufficient generic distinction among the ferns, he determines it in the affirmative, inasmuch as a genus being in his view an arbitrary group, all that is really required as a generic character is a constant difference from established genera in the structure of some important organ or system of organs. Now the vascular system must be regarded as of the highest importance in the vegetable œconomy

even in reference to propagation, it being not at all unfrequent to meet with extraordinary means of development in connexion with it, viz. adventitious buds; and in ferns particularly those points of the veins which serve in normal cases as the receptacles to which the sori are attached, in other cases become viviparous and develope gemmæ from which new plants are produced. He believes, moreover, that characters derived from this system of vessels, when taken in connexion with the fructification, though sometimes forming groups of considerable extent, and occasionally separating species having some external similarity, nevertheless in no case bring together obviously ill-assorted species, but rather associate those of obvious similarity and affinity.

For these reasons he is not prepared to follow Sir W. Hooker in setting aside the genus *Hewardia* of Mr. John Smith. He regards the difference as broad and important between the accidental anastomosing of contiguous venules which occurs in some species of *Adiantum*, and a constant and complete reticulation, such as exists in the genus *Hewardia*; and he concludes that that genus should be retained. This conclusion he finds unexpectedly confirmed in Fée's 'Genera Filicum,' just received in this country, where the same view is taken of the species of *Hewardia* as that which he had previously adopted, and an additional species (*H. serrata*) mentioned of which he had no previous knowledge.

The species enumerated by the author are arranged as follows:—

* Sori continui; venæ primariæ costiformes.

1. *Hewardia adiantoides*, J. Smith = Adiantum Hewardia, *Kunze*.
2. *H. dolosa*, Fée = Ad. dolosum, *Kunze*.

** Sori interrupti; venæ uniformes.

3. *H. Le Prieurei*, Fée = Ad. Le Prieurei, *Hook*.
4. *H. serrata*, Fée.

Mr. Moore regards *H. Wilsoni*, Fée (Adiantum, *Hook.*), as a true *Adiantum*; as also Sir W. Hooker's variety γ. of *Ad. lucidum*. In both these the dichotomous veins occasionally anastomose; but there is nothing like complete reticulation, and the union, when it does occur, is evidently accidental.

If the name *Hewardia* be retained, as the author proposes, for the genus of ferns to which it was first applied, he suggests that of *Isophysis* for the Melanthaceous genus, subsequently so called by Sir William Hooker in his 'Icones Plantarum,' t. 858, the species retaining the name of *Tasmanica*.

The same rule induces the author, in the second case referred to, to separate from the genus *Deparia*, Hook., a species having a truly and constantly reticulated venation, that of *Deparia* being uniformly free. The species in question is *Deparia Moorii* from New Caledonia, named by Sir Wm. Hooker after Mr. C. Moore, the Director of the Sydney Botanic Garden, by whom it was discovered; and the following are its generic characters:—

Cionidium, *T. Moore in Gard. Comp.* (nomen tantùm).

Char. Gen. *Venæ* reticulatæ. *Sori* semi-globosi, extra-marginales, in venularum apicibus excurrentibus pedicellati; *capsulis* pedicellatis. *Indusia* stipitata, subcyathiformia.—Frondes *bipinnatæ*; soris *ex utrâque pinnularum pinnatifidarum margine prominulis.*

Cionidium Moorii, T. Moore, *l. c.*

Deparia Moorii, *Hook. in Journ. of Bot.* iv. p. 54. t. 3.

Hab. in Novâ Caledoniâ, *D. C. Moore* (1851).

February 15, 1853.—R. Brown, Esq., President, in the Chair.

Mr. Yarrell, V.P. and Treas. L.S., exhibited a specimen of the Sooty Tern (*Sterna fuliginosa*, Lath.), a species new to Britain and even to Europe, which was killed in October last at Burton-on-Trent, was preserved for, and belongs to the collection of H. W. Desvœux, Esq.

Read an "Additional Note" to Mr. Newport's memoir on *Ichneumon Atropos*, Curt., in reference to the changes which take place in the alimentary canal after the parasite has ceased to feed, and while assuming its imago state. These changes, which are very considerable both as regards form and condition, are minutely described; and every part of the canal is shown to be supplied with tracheæ, the trunks of which, one in each segment, passing transversely inwards, divide into branches, which, again subdivided, penetrate into and ramify through the structure. These, like all other tracheæ, are formed, as described by Sprengel, of three tissues, an external *membranous* and an internal *mucous*, enclosing between them a strong spiral fibre. The nature and origin of the external tissue have been shown by Mr. Newport in previous memoirs; but he has since found that the ramifications of the tracheæ which penetrate the structure of the canal, or of any other organ, become denuded of this external covering, and then seem to be formed only of two tissues, the spiral and the mucous, if indeed there be not also, as he has some reason to think, an extremely delicate serous, or basement membrane, closely adherent to and uniting the coils of fibrous tissue on its external surface. The *ultimate divisions* of the tracheæ are always distributed separately, and *do not anastomose*, ending, as noticed by Mr. Bowerbank, in extremely minute, filiform, blind extremities; and this Mr. Newport finds to be their condition in all structures, in the nervous and tegumentary, equally as in the glandular and muscular. These facts, the author observes, may perhaps assist us to understand the nature of the injection of the tracheæ by M. Blanchard, and also the mode of nutrition in insects; the ultimate branches of tracheæ in the tissues of the alimentary canal operating, possibly, as absorbent structures, and inducing the chylific fluid elaborated around them to flow, in its transit outwards, along the channels formed by their loose peritoneal covering into the regular circulatory currents. Further, they may assist to explain the mode of coloration of the tracheæ in the experiments of MM. Alessandrini and Bassi, and of M. Blanchard, and also in others, yet

unpublished, made by himself on the larvæ of *Clissocampa Neustria*, in July 1837.

April 5, 1853.—R. Brown, Esq., President, in the Chair.

Read a "Note on the Nature of Fasciated Stems." By the Rev. William Hincks, F.L.S., Professor of Natural History in Queen's College, Cork.

The author lays it down as an indubitable principle, that what we call monstrosities or anomalies, either in the animal or vegetable kingdom, are always susceptible of explanation from the operation, under unusual circumstances, of causes or principles the ordinary operation of which produces the normal structure of the species. Hence they are always worth studying until a satisfactory explanation of their nature has been arrived at, and even when that is accomplished they have still an interest as illustrations of principles which we apply in the explanation of normal structures, or as proofs of the truth of particular views in respect to the origin or relations of parts in certain tribes. In accordance with this view of the importance of such investigations he proceeds to the consideration of the nature of fasciated stems, which, in concurrence with the view taken by Linnæus in his 'Philosophia Botanica,' he is disposed to regard as formed by a group of coherent stems. According to this view the real peculiarity would consist in the number and remarkable arrangement of the buds, the coherence of stems brought together in such a relative position being, as shown by innumerable examples, a matter of course. Having regard to the crowded or unusually placed buds which are found in the anomaly called plica, tracing this cohesion upwards from the not uncommon adherence of two stems, and observing what must necessarily happen from numerous branches occurring together, it seems to him that the fascia is by no means difficult of comprehension. The striæ which it almost invariably presents exhibit the traces of the lines of junction; and the curved or spiral contraction, which is so often met with, is perhaps accounted for by the growth in connexion with each other of internodes of unequal length. He would not, however, affirm that every stem which is called fasciate is composite in its nature; for that term has been extended to cases of riband-like expansion, which, although dependent also on excess of nourishment, are distortions of a single stem.

Mr. Hincks then refers to the objections taken to the theory of Linnæus by several recent physiologists, and most clearly and explicitly stated by M. Moquin Tandon in his 'Tératologie Végétale' under the following heads:—1. "We find plants with a single stem fasciated (as *Androsace maxima*), and nothing announces to us that we have in this case several individuals united together." 2. "On certain fasciated stems we may remark that the branches are of the same number and the same arrangement as in the normal condition." 3. "Two branches accidentally united in the direction of their length form a body of which the transverse section presents a figure more or less resembling a figure of 8, if the coherence is recent or slight,

and an elliptic or rounded figure if it is of long standing or very intimate: traces of two medullary canals are almost always found. In a fasciated stem the section gives an elongated figure in which we commonly observe only one compressed canal." 4. "To obtain a fasciated stem by coherence a great number of united branches would be required; but though an accidental union of two branches or of three may be admitted, it is very difficult for it to occur at the same time among four, five, or six. It is very difficult to suppose that these branches should all meet longitudinally, and that the union, instead of taking place around the central axis, should be entirely in one direction." 5. "If fasciated stems were the result of many combined branches, we ought to find cases in which the union is incomplete, and to be able to observe on their surface such a distribution of leaves or buds as would announce the fusion of many partial spirals or verticils."

Setting aside the anomalies before alluded to, and guarding against the assumption that mere adherence explains an appearance which chiefly depends upon a peculiar position of buds and the production of numerous branches in a certain relation to each other, Mr. Hincks regards these arguments as not possessing any great weight. In regard to the 1st he remarks, that herbaceous plants which have usually but a single stem, not unfrequently produce several, which often remain distinct, but their union into a sort of fasciated stem is by no means uncommon. In proof of this he showed specimens of *Primula vulgaris* and *Hieracium aureum*, exhibiting the union of two stems so produced, and of *Ranunculus bulbosus* showing still greater complexity in the stem, while the principal flower appeared to be made up of two or three combined. The 2nd objection may appear in certain cases to be just, but the author is of opinion that it is hazardous to conjecture that we have no more leaves present in a fasciated stem than we should have in the same space in an ordinary one, and he referred to specimens on the table as distinctly proving that an increased number of leaves and buds is a general character of fasciated stems. M. Moquin Tandon himself has, indeed, referred to an instance in *Bupleurum falcatum* where the leaves had been whorled, doubtless, Mr. Hincks observes, from those belonging to two or more stems being collected together. The 3rd argument he regards as very deceptive, for the nature of the transverse section presented by coherent stems must depend not only on the intimacy of their union, but also on the internal structure of the stems themselves. When two flowers adhere without much pressure, they exhibit uniting circles somewhat resembling a figure of 8, but when more completely combined they have one circumference of a much-elongated figure, and something similar is to be expected in herbaceous stems. Even the elongated pith of a transversely cut woody fasciated stem only marks the intimate union of several branches; and the author has noticed instances of the union of two and only two stems when the internal appearance was the same as in other fasciations. The 4th objection is derived from the improbability of the lateral union of many stems;

but in addition to the common examples of the union of two stems, the author appealed to a distinct case of a union of four flower-stems of *Scrophularia aquatica* so complete that a composite flower was formed containing all the parts of the four component flowers, and produced a fasciated stem of *Ranunculus bulbosus*, where the union of several stems terminated in a flower having at least double the usual number of parts, as indisputable evidence of the fact. He also laid before the Meeting examples of numerous branches laterally arranged as if ready to combine, in immediate connexion with fasciated stems, which, according to his view, are made up of similar branches already combined. To the 5th and last objection he answers that cases in which the adherence is incomplete, and on which the marks of fusion of several stems are to be perceived, are in fact frequently met with, and may be appealed to as strong direct evidence in favour of the Linnean theory. A striking example is given in DeCandolle's 'Organographie Végétale' (pl. 3. f. 1) in a stem of *Spartium junceum* having several branches only imperfectly fasciated; and similar specimens of *Aucuba Japonica* and *Cotoneaster microphylla* were exhibited, together with a fasciated *Ash*, in which the traces of numerous stems were observable upon the surface.

The author stated his conclusion to be, "that the fasciated stem is best explained from the principle of adherence, where, from superabundant nourishment, especially if accompanied by some check or injury, numerous buds have been produced in close proximity; and that the supposition of a leaf-like expansion of the elements of a single stem is insufficient to explain the usual appearances, and is founded on a false analogy between fasciated and certain other anomalous stems."

The specimens exhibited were from a collection formed by the author and now in the Museum of Queen's College, Cork. They consisted of—1, an intimate adherence of two stems of *Bunium flexuosum*; 2, an entire adherence of two stems with their heads of flowers of *Hieracium aureum*, and of two or more stems of *Primula veris*; 3, a fasciated stem of *Ranunculus bulbosus*, with the terminal flower formed by the union of two, and the stem showing other signs of composition; 4, a fasciated stem of *Cheiranthus Cheiri*, apparently consisting of at least three united branches; 5, a fasciated stem of *Veronica maritima*; 6, two stems of the same plant, in which the buds which usually produce individual flowers have produced secondary stems themselves flower-bearing, so as to transform a simple into a compound spike; 7, a fasciated stem of *Aucuba Japonica*, seeming to prove the composite nature of such stems; 8, a fasciated stem of *Cotoneaster microphylla*, in which the composite structure is peculiarly evident; 9, a fasciated stem of *Fraxinus excelsior* showing a crowd of buds and of small branches in a linear series at the extremity of fasciated portions, and also showing the curved contraction of the fasciated branches from weaker branches being connected with a stronger one. The author also referred to a remarkable fasciculation of *Asparagus officinalis* in the same collection, the upper portion of which is spirally twisted, and the crowded branches from

which seem to prove the presence of several stems; and to some fine specimens of fasciations from the Society's collection which were placed upon the table.

April 19, 1853.—R. Brown, Esq., President, in the Chair.

Mr. Westwood, F.L.S., communicated a notice of the discovery in England of a new genus and species of Amphipodous *Crustacea*, the *Niphargus stygius* of Schiödte, an animal hitherto only found in the caverns of Adelsberg, celebrated as the locality of the *Proteus anguinus*. The Crustacean in question has been found in great numbers in a well near Maidenhead, the water of which was in consequence rendered unfit for use. Mr. Westwood took occasion to remind the Members of the opinion entertained by some naturalists of the existence of a distinct subterranean fauna of which the *Proteus* was an example; the members of which fauna hitherto discovered were remarkable for their general want of colour, and for their being destitute of eyes, two physiological conditions dependent on the dark and gloomy places where they have hitherto been found.

Mr. Kirby, in his 'Bridgewater Treatise,' was one of those writers who contended that such animals formed no part of the fauna now in existence on the surface of the earth, but belonged to a distinct subterranean race of animals. M. Schiödte, in a remarkable memoir recently published in the Transactions of the Danish Academy (which Dr. Wallich has kindly translated for the Entomological Society of London, in whose memoirs the translation has appeared), has described a number of singular animals belonging to the class of *Annulosa*, exhibiting all the characteristics of such a fauna, being destitute of sight and also almost or quite colourless. Amongst them are the Crustacean in question, a species of Spider and false Scorpion, a species of the family *Poduridæ*, and several *Coleoptera*, all of which were found in the caverns of Adelsberg in Carniola. Mr. Westwood also noticed that animals very closely related to those described by Schiödte had been found in the Great Mammoth Cave in Kentucky, including also a blind species of Cray-fish, and one or more species of fishes destitute of eyes, at least wanting the transparent external cornea, although the optic nerve was present, which would probably allow a certain sensibility to the presence of light; and M. Schmidt had noticed that two newly discovered species of Beetles belonging to one of Schiödte's singular genera had, although destitute of all external rudiments of eyes, exhibited a sensibility to light by retreating under stones and towards the darker parts of the cavern when brought towards its entrance. A remarkable new genus of Shrimps had also been recently described by Professor Bell in his work on British *Crustacea*, dredged at a very great depth of the ocean, of which the eyes, although present, were destitute of the usual hexagonal facets.

Read a paper "On the Ocelli in the genus *Anthophorabia*, Newp." By George Newport, Esq., F.R.S., F.L.S., &c.

The author remarked that since the publication of his observations on these insects in the 'Transactions' of the Society, his attention

had again been directed to the peculiarities of the organs of vision in the male sex. He had already shown that these individuals possess only ocelli at the sides of the head as well as on the vertex, but that these structures exist at precisely the same parts of the head as the ocelli and the compound eyes in the female, and consequently that there can be no doubt of their homology. These appearances, however, having led some to question the correctness of this, it became necessary, in order to judge aright of their nature, to consider what are the essential conditions of a structure which is specially destined *for the appreciation of light*. This consists, as already pointed out in *Fishes*, of a follicle or pit in the tegument of the head, coated with dark pigment, and receiving the distal termination of a particular cerebral nerve, conditions which are precisely those of the ocelli, both of the sides of the head and of the vertex, in *Anthophorabia*. The various modifications of the eye in insects, with regard to the form of the cornea, the depth of the chamber, and the presence of the choroid, and of the lens, with reference to the extent of field, and the focal distance, of vision, were pointed out, and the degree in which they exist in *Anthophorabia* mentioned, as coinciding with the peculiar habits of the insect. The structures in the male were thus shown, by the presence of cornea, chamber, choroid, and nerve, to be most indisputably organs of sight. The author referred also to the binary origin of the nerve of the middle ocellus of the vertex, as formerly pointed out by him in his paper on *Pteronarcys*; to the origin of ocelli in the same way as other dermal tubercles; and to the imperfect eye-spots in the *Scorpionidæ* being supplied with nervous filaments from the same optic nerve which supplies the recognised organs of vision in those animals.

May 3, 1853.—R. Brown, Esq., President, in the Chair.

Read a memoir "On the Vegetation of Buenos Ayres and the neighbouring districts." By Charles James Fox Bunbury, Esq., F.R.S., F.L.S., &c.

ZOOLOGICAL SOCIETY.

May 13, 1851.—John Edward Gray, Esq., F.R.S., in the Chair.

The following papers were read:—

1. Observations on the Eye of the Mole, in a letter addressed to W. Spence, Esq., F.R.S. By John Davy, M.D., F.R.S.

In a letter with which you favoured me some weeks ago, you made mention of Schiödte's 'Faunæ Subterraneæ Specimen,' and of the interesting discoveries described in it of several species of eyeless animals, the inhabitants of caves into which the sun's rays never penetrate, and where, in utter darkness, visual organs would consequently be useless.

Reflecting on the subject, I thought it worth while to examine with some care the eyes of the common Mole, an animal that spends the greater portion of its time beneath the surface of the earth, and seems in its general organization specially adapted for a subterraneous life.

I shall chiefly notice what, in the dissections I have made, appears to be peculiar.

The first peculiarity that arrests attention is, that the eyes of the Mole are not contained in bony sockets, but lie unprotected by any bony prominences in the cellular tissue, beneath the common integuments; and, in consequence, were this animal an extinct one, and its skeleton found in a fossil state, there being no orbit, the palæontologist might be led to infer that it is a species destitute of eyes.

The next peculiarity I would mention is in regard to eye-lashes. These too it seems to be destitute of. The hair in which the eyes are buried, and by which they are defended, seems to be the common fur of the head. I could detect in that immediately surrounding them no hairs of larger dimensions, or in any respect different from those of which its fine fur is composed.

The apertures for the admission of light constitute another peculiarity. When the fur is removed from the skin surrounding the eyes, a minute aperture appears over each, about $\frac{1}{25}$th of an inch in length when closed, and, in this state, linear and straight, but circular when fully expanded. The extreme margins of these openings in the integuments being covered with fur, there is no well-marked appearance of eyelids,—indeed, it may be a question, whether the Mole, in strictness, can be said to possess these appendages. From the observations I have made, I am disposed however to infer that it does possess them, but imperfect;—imperfect, not having been able to detect beneath the marginal cutis any vestige of ciliary cartilages, and yet having found in the surrounding subcutaneous cellular tissue muscular fibres so arranged as if designed for closure, resembling an orbicular muscle, and probably designed for and performing the part of such a muscle.

As to the other muscles of the eye, one only, an abductor, was distinguishable from adjoining muscles. It is of large size comparatively, and it may be inferred powerful: by acting on it, seizing it with a forceps, and drawing it upwards, the ball of the eye was retracted, thus denoting its office. I sought in vain for other muscles. That they were not discovered, supposing them to exist, is not surprising, considering the smallness of the organ and its peculiar uninsulated position, most unfavourable for discriminating the subordinate parts pertaining to it, such as the muscles.

Relative to the constituent parts of the organs themselves, excepting their delicacy and minuteness, I am not aware of any peculiarity. The eye-ball is about $\frac{1}{25}$th of an inch in diameter; the iris dark brown; the pupil circular; the lens about $\frac{1}{163}$rd of an inch in diameter. Traces of a vitreous humour, and also of an aqueous, were observable; the former in the appearance of a cellular texture, as seen under the microscope with a high power; the latter as an exudation of moisture, a just perceptible quantity of fluid, when the ball was

ruptured. From the situation of the eyes low down in the face, the optic nerves are necessarily of unusual length.

The dissections, of which I have thus briefly given the results, I need hardly remark were made chiefly under water, and with the aid of the microscope.

To return to the subject which led to the inquiry, viz. the subterraneous eyeless Fauna brought to light by the Danish naturalist, you in your letter briefly advert to the speculations which this curious discovery gives rise to, as, "whether these animals originally had eyes, and have lost them from want of use by inhabiting for ages dark caves; or, whether they were originally created without eyes, for those abodes where they have no occasion for them," &c. Allow me to ask—fully appreciating the difficulty of solving such problems—whether the preceding observations on the eyes of the Mole are not rather in favour of the latter than of the former solution? It is easy to imagine how the optic nerve and the more important parts of the organ of vision might diminish in size from little use; but it is difficult to suppose that the same circumstance could have any material effect in obliterating a cavity in bone—the eye's orbit—and, if the Mole's eyes were thus originally designed, why may not the eyeless animals have been formed in the first instance without eyes? Do not we see throughout Nature the most perfect harmony between the organic structure and the modes of life and habits of the living beings, so that the one is the true index of the other,—and that in the most minute details? Excuse my touching on these speculative questions, which, probably, from their nature, always must be speculative,—unless indeed the eyeless species are found otherwise identical with species possessing eyes, and there be found also a gradation in them, as to power and size in accordance with the degrees of light to which the individuals have been habituated, as in advancing from the open air and the entrance of the dark abodes to their deepest recesses. Also, excuse me if the matter of this letter should not be new to you.

Lesketh How, Ambleside, April 28, 1851.

P.S.—It may be deserving of mention, that notwithstanding the small size of the eye of the Mole, its appearance in fœtal development is early: thus, in a fœtus which I have recently examined, the length of which was about three-quarters of an inch, the eyes were distinct; they were visible—conspicuous in the naked face, even without the aid of a magnifying glass, and indeed were not much smaller than those of the adult, and but little different in appearance: the diameter of each was about $\frac{1}{100}$th of an inch.

2. Notice of two Viverridæ from Ceylon, lately living in the Gardens. By J. E. Gray, Esq., F.R.S. etc.

The specimens here noticed were brought from Ceylon by Alex. Grace, Esq., and lived some time in the Gardens of the Society.

The first is the species which I described some years ago under the name of *Herpestes Smithii* (Mag. Nat. Hist. 1837, ii.), from a specimen which was living in the Surrey Zoological Gardens, now pre-

served in the Collection of the British Museum: that specimen was said to have been sent from the Cape of Good Hope, but this must have been a mistake, as it is quite unknown to Dr. Burchell, Dr. A. Smith, Mr. Smut, Dr. Wahlberg, or other zoologists who have written on the animals of South Africa.

Mr. Grace informs me that it is an inhabitant of the interior part of Ceylon. It is by far the most beautiful species of the genus.

The second is a new species of Cynictis, which I propose to call

Cynictis Maccarthiæ.

Teeth normal. Red brown; hair elongate, flaccid, pale brown, with a broad, black subterminal band, and a long whitish brown tip; of hands and feet shorter. Feet blackish brown, hair white tipped. Claws elongate, slender, compressed, especially of the two middle toes of the fore feet. Tail redder; hair elongate, one-coloured, red. Ears rounded, hairy.

Hab. Ceylon; Jaffna, North of Ceylon (*A. Grace, Esq.*).

This species somewhat resembles *Cynictis melanura* in general colour, but the hairs are much longer, not so adpressed, and, when the individual colour of the hair is examined, most distinct.

I have proposed to name this interesting animal after Mrs. MacCarthy, the wife of the Treasurer of the Colony and the daughter of Mr. Hawes, the Assistant Secretary to the Colonies, who is much interested in the study of natural history, and has kindly sent me several very interesting natural productions from Ceylon.

The skull differs from all the other Herpestes that I have examined, in the back of the nape being deeply and sharply notched instead of transversely truncated, the notch in the living animal being filled up with a cartilaginous septum.

3. Descriptions of fifty-two new species of the genus Mitra, from the Cumingian Collection. By Arthur Adams, F.L.S. etc.

1. Mitra serotina, A. Adams. *M. testâ oblongo-fusiformi, acuminatâ, serotinâ; spirâ productâ, longitudinaliter plicatâ, plicis confertis, undulatis; transversim sulcatâ, sulcis subdistantibus; aperturâ anticè dilatatâ; columellâ quadriplicatâ, basi contortâ et recurvâ; labro intus lirato, margine recto, anticè subangulato.*

Hab. Marquesas.

A light orange species, with a produced spire, and the outer lip produced and rather angulated anteriorly.

2. Mitra cratitia, A. Adams. *M. testâ oblongo-fusiformi, albidâ, nitidâ, liris elevatis transversis, acutis, et lineis elevatis, longitudinalibus, decussatim ornatâ; interstitiis subtilissimè longitudinaliter striatis; aperturâ intus aurantiacâ; columellâ plicis quinque instructâ.*

Hab. South Africa.

The shell from which the description is taken is worn, and not in

good condition, but it appears to be distinct from any species already described.

3. Mitra straminea, A. Adams. *M. testâ oblongo-fusiformi, stramineâ; anfractibus planulatis, liris transversis rugulosis, interstitiis cancellatis, suturâ subcanaliculatâ; aperturâ oblongâ, anticè subproductâ; columellâ plicis quatuor, basi subrecurvatâ; labro intus lævi.*

Hab. ——?

An oblong, transversely-ridged species, rather faintly cancellated between the interstices.

4. Mitra insignis, A. Adams. *M. testâ ovato-acuminatâ; spirâ acutâ, lævi, nitidâ, albidâ; anfractibus planis, fasciâ angustâ albo fuscoque articulatâ, ornatâ; anfractu ultimo anticè transversim striato; columellâ sinuatâ, biplicatâ, anticè incurvatâ.*

Hab. Rains Island (*Mr. Ince*).

This is a very peculiar form, reminding one almost of the genus *Pusionella* of Gray.

5. Mitra lævis, A. Adams. *M. testâ oblongo-fusiformi, apice acuto, lævi, nitidâ, albidâ; anfractibus planis, supremis cancellatis, ultimo fasciâ latâ transversâ, rufescenti ornato; columellâ plicis quatuor, supremis magnis imbricatis.*

Hab. Zanzibar.

A smooth *Oliva*-shaped species, with a polished surface, and a red-brown band blending into the white of the last whorl; the plates of the columella are imbricate.

6. Mitra tigrina, A. Adams. *M. testâ oblongo-ovatâ; spirâ crassiusculâ, apice mucronato, rufo, albo strigosâ; anfractibus planiusculis, transversim subsulcatis; columellâ plicis quinque; labro intus rufo.*

Hab. Philippines.

Several specimens of this species, all agreeing in form, were collected by Mr. Cuming; but one only retained the natural colour of the surface.

7. Mitra tiarella, A. Adams. *M. testâ oblongo-ovatâ, fuscâ, nodulis albis, ad suturas coronatâ, longitudinaliter subplicatâ, transversim liratâ, interstitiis valdè punctatis; columellâ plicis quatuor; labro margine crenulato.*

Hab. Island of Ticao, sandy mud, 6 fathoms.

This small, brown-coloured species is beautifully crowned, in adult specimens, with a diadem of white nodules at the suture of the whorls.

8. Mitra pigra, A. Adams. *M. testâ oblongo-fusiformi, obscuro-fuscâ, lineis pallidulis transversis prope suturas, albidâ, maculis rufis, ornatâ; lævi; spirâ acuminatâ; anfractibus septem, planulatis; aperturâ subdilatatâ, intus albâ; columellâ plicis quatuor, albis, obliquis, instructâ, anticè subintortâ.*

Hab. Australia.

This species partakes somewhat of the character of *M. sacerdotalis*.

9. Mitra luctuosa, A. Adams. *M. testâ oblongo-fusiformi, obscuro-fuscâ, fasciâ unicâ pallidâ transversâ ornatâ; spirâ acutâ, anfractibus planulatis, transversim liratâ; interstitiis valdè clathrato-punctatis; aperturâ oblongo-ovatâ; spirâ breviori; labio crassiusculo; columellâ plicis quatuor salientibus.*

Hab. China Seas.

This species was obtained during the voyage of H.M.S. Samarang.

10. Mitra insculpta, A. Adams. *M. testâ ovato-fusiformi; spirâ brevi, acutâ; aperturâ breviori; anfractibus planulatis, pallidè fuscâ, maculis rufis, longitudinalibus, variegatâ; cingillis integris, acutis, prominentibus, æquidistantibus; liris intermediis submoniliformibus; interstitiis longitudinaliter valdè sulcatis; aperturâ elongatâ; columellâ plicis tribus; labro acuto margine crenulato.*

Hab. Ceylon (*Dr. Gardner*).

This species also belongs to the same group as *M. cingulata*.

11. Mitra exarata, A. Adams. *M. testâ ovato-fusiformi; spirâ aperturam æquante; anfractibus subrotundis; suturâ subcanaliculatâ, olivaceâ, fasciis duabus pallidis transversis, longitudinaliter costatâ; costellis æqualibus, subdistantibus; interstitiis lineis insculptis, profundis, transversis; columellâ plicis tribus, validis, instructâ.*

Hab. Bais, island of Negros, coarse sand, 7 fathoms.

The most characteristic feature of this species is the sculpture between the ribs, consisting of deep, engraved, transverse lines.

12. Mitra rufocincta, A. Adams. *M. testâ ovato-fusiformi; spirâ aperturam æquante; anfractibus rotundis, sordidè albâ, fasciâ transversâ latâ rufo-fuscâ; longitudinaliter costatâ, costis obtusis, rotundis, distantibus; interstitiis lineis impressis transversis; aperturâ subdilatatâ; columellâ plicis quatuor instructâ; labro tenui anticè dilatato.*

Hab. ——?

A small, slightly-worn specimen serves for this description, but it is of peculiar form and sculpture.

13. Mitra nitida, A. Adams. *M. testâ ovato-fusiformi; spirâ aperturâ breviori; anfractibus subrotundis, lævi, nitidâ, badiâ, anfractu ultimo anticè et posticè sulcis nonnullis transversis instructo; aperturâ oblongâ, anticè subdilatatâ; columellâ plicis quatuor; labro simplici.*

Hab. ——?

A small, brown, shining species, with only a few transverse spiral lines for sculpture.

14. Mitra compta, A. Adams. *M. testâ ovato-fusiformi; spirâ aperturâ longiore; anfractibus subrotundis, supernè angulatis,*

sordidè albâ, longitudinaliter plicatâ; transversim liratâ, liris apud plicas nodulosis; interstitiis valdè et regulariter clathratis; anfractu ultimo anticè angustato et reflexo; columellâ plicis quinque instructâ; labro internè sulcato, margine crenulato.

Hab. China Seas.

This species, remarkable for the strong cancellations between the longitudinal plicæ, was brought home in H.M.S. Samarang.

15. Mitra ligata, A. Adams. *M. testâ ovato-fusiformi; spirâ aperturâ longiore, anfractibus planis; castaneo-fuscâ, lineâ unicâ pallidâ, transversâ in medio anfractuum, longitudinaliter plicatâ, transversim subliratâ; columellâ plicis quatuor; labro simplici, margine acuto.*

Hab. Pasacao, province of South Camarinas; isle of Luzon, on the sands.

The colouring of this species is very different from the allied species, and the sculpture is peculiar to many species belonging to the subgenus *Turris* of Schumacher.

16. Mitra vibex, A. Adams. *M. testâ ovato-fusiformi; spirâ aperturam æquante; anfractibus rotundis; fuscâ, prope suturas palliduld, zonulâ albâ angustâ transversâ in medio anfractuum; longitudinaliter corrugato-plicatâ, transversim liratâ, liris apud plicas nodulosis; interstitiis longitudinaliter striatis; anfractu ultimo angustato et anticè subreflexo; columellâ plicis quatuor instructâ; labro acuto.*

Hab. ——?

This species somewhat resembles *armillata* of Reeve, but the corrugated nature of the plicæ distinguishes it.

17. Mitra interrupta, A. Adams. *M. testâ ovato-fusiformi; spirâ acuminatâ; aperturâ breviori; anfractibus planis, prope suturas angulatis; albidâ, rufo-fusco variegatâ; cingulâ transversâ fuscâ moniliformi in medio anfractuum; longitudinaliter plicatâ, plicis æqualibus, obliquis, obtusis, distantibus; transversim corrugato-liratâ; interstitiis punctatis; anfractu ultimo anticè recurvato; columellâ supernè excavatâ, plicis tribus instructâ; labro simplici.*

Hab. North Australia.

The peculiar interrupted, dark, transverse band distinguishes this elegant species.

18. Mitra eximia, A. Adams. *M. testâ ovatâ; spirâ brevi, obtusâ; nitidâ, aurantiacâ, maculis triangularibus albis, cingillis lævibus, latis, transversis; interstitiis valdè longitudinaliter clathratis; aperturâ lineari-oblongâ; columellâ plicis quatuor; labro intus lævi, margine crenulato.*

Hab. ——?

This pretty little species belongs to the same group as *M. læta*, but the sculpture and markings are quite different, although the colour is nearly similar.

19. Mitra multilirata, A. Adams. *M. fusiformis, spirâ acuminatâ, aperturam æquante; anfractibus rotundatis, ad suturas angulatis; pallidè rufo-fuscâ, cingillis lævibus transversis, æquidistantibus, obtusis, ornatâ; interstitiis lineis longitudinalibus, elevatis, subconfertis, instructis; anfractu ultimo anticè producto et subreflexo; columellâ anticè truncatâ, plicis quatuor instructâ; labro intus sulcato, margine crenulato.*

Hab. China Seas.

This species was obtained during the voyage of H.M.S. Samarang.

20. Mitra læta, A. Adams. *M. testâ ovatâ, crassiusculâ, aurantiacâ, punctis albis ornatâ; longitudinaliter plicatâ; anfractibus planiusculis, transversim nodoso-liratâ; interstitiis simplicibus; columellâ plicis quinque instructâ; labro crenulato.*

Hab. Ticao, under stones, low water.

An oblong-ovate, shining, orange species, with scattered round white granules and regular nodulose liræ; the spire is obtuse; the whorls are flattened and longitudinally plicate.

21. Mitra ornata, A. Adams. *M. testâ oblongo-fusiformi, acuminatâ; spirâ acutâ; anfractibus novem, ad suturas angulatis; suturâ subcanaliculatâ; albâ, fasciis transversis rufo-fuscis ornatâ; longitudinaliter costatâ; costis regularibus, obliquis, subcrenatis; interstitiis transversim valdè clathratis; anfractu ultimo anticè subumbilicato et recurvo; columellâ plicis quatuor; labro posticè subangulato.*

Hab. ——?

This species is peculiar for its regular form and exactness of sculpture, as well as for its beauty of colouring.

22. Mitra nodilirata, A. Adams. *M. testâ oblongo-fusiformi, pallidè fulvâ, fasciâ latâ rufâ transversâ ornatâ; spirâ acuminatâ, turritâ; anfractibus octo planis, infra suturas angulatis; nitidâ, longitudinaliter plicatâ; plicis distantibus, prominentibus, obliquis, prope suturas valdè nodulosis; interstitiis lineis impressis transversis ornatis; columellâ plicis quatuor; labro acuto.*

Hab. ——?

An elegant form, with the pliciform ribs strongly nodulose at their hind part.

23. Mitra pura, A. Adams. *M. testâ fusiformi; spirâ aperturâ longiori; anfractibus subplanulatis; albâ; cingulis transversis angustis, subelevatis, crenulatis, rufo subarticulatis; liris tribus intermediis; interstitiis valdè punctatis, ornatâ; aperturâ oblongâ, anticè dilatatâ; columellâ plicis quinque; labro intus sulcato, margine crenato.*

Hab. ——?

An elegantly formed species, with the last whorl somewhat recurved.

24. Mitra cingulata, A. Adams. *M. testâ ovato-fusiformi; spirâ acutâ, aperturam æquante; anfractibus planulatis; sordidè albâ; cingillis prominentibus subcrenulatis, acutis, transversis;*

interstitiis longitudinaliter valdè clathratis, ornatâ; anfractu ultimo anticè producto et recurvato; columellâ plicis tribus.

Hab. ——?

This species belongs to that group in which the whorls are encircled with transverse ridges.

25. Mitra reticulata, A. Adams. *M. testâ ovato-fusiformi; spirâ aperturâ breviori; anfractibus subrotundis; albâ; cingulis transversis, æquidistantibus, acutis, crenulatis, sulcis obliquis longitudinalibus decussatis, ornatâ; columellâ plicis quatuor; labro intus sulcato.*

Hab. Port Essington, 7 fathoms, sandy mud (*Jukes*).

Remarkable for the acute, crenated, transverse ridges which give the surface a reticulated appearance.

26. Mitra asperulata, A. Adams. *M. testâ oblongo-fusiformi, pallidè rufo-fuscâ, ad suturas albidâ, longitudinaliter sulcatâ, transversim liratâ, liris nodulis, subacutis, asperulatis; spirâ productâ; anfractibus sex, subrotundis; aperturâ spiræ dimidium æquante, anticè abruptè truncatâ; columellâ plicis tribus; labro acuto.*

Hab. Australia.

The transverse ridges are set with subacute nodules, which give a rough appearance to the surface.

27. Mitra mirabilis, A. Adams. *M. testâ fusiformi; spirâ acuminatâ, aperturâ longiori; anfractibus novem, planulatis, supernè angulatis; albâ, maculis rufis triangularibus, et punctis transverso-elongatis, rufescentibus, ornatâ; longitudinaliter plicatâ, plicis obtusis, regularibus, distantibus, nodosis; nodis posticè prominentibus; cingulis transversis nodulosis, obtusis, elevatis, instructâ; anfractu ultimo in medio angustato; anticè productâ et subreflexâ; aperturâ elongatâ; columellâ plicis quatuor; labro posticè angulato, in medio inflexo, intus sulcato, margine crenulato.*

Hab. Socotra.

28. Mitra albina, A. Adams. *M. testâ oblongo-fusiformi, albâ; spirâ conicâ, longitudinaliter plicatâ; anfractibus subrotundatis, liris transversis ornatis; anfractu ultimo lævi, posticè subplicato, anticè sulcis transversis punctatis ornato; columellâ plicis quinque; aperturâ oblongo-lineari; labio subcalloso; labro acuto.*

Hab. Batangas, Isle of Luzon, on the reefs.

This *Mitra* is perfectly white, and of a very peculiar form; Mr. Cuming possesses but a single specimen.

29. Mitra amœna, A. Adams. *M. testâ oblongo-fusiformi, albâ, maculis rufis variegatâ; spirâ acuminatâ; anfractibus octo, subrotundis, carinulis transversis, lævibus, elevatis, rufo-fusco articulatis, lirâ intermediâ crenulatâ, interstitiis eleganter longitudinaliter clathratis; aperturâ angustâ; columellâ plicis quinque; labro tenui, acuto.*

Hab. Red Sea.

This elegant species belongs to the annulated group.

30. Mitra rutila, A. Adams. *M. testâ oblongo-fusiformi, acuminatâ, aurantiacâ, maculis albis sparsis ornatâ, fasciis pallidis transversis prope suturas, suturis maculis aurantiacis maculatis; spirâ productâ, acutâ; anfractibus septem, transversim liratâ; anfractu ultimo liris anticè distinctioribus; aperturâ dilatatâ; columellâ plicis quatuor; labro acuto, anticè crenato.*
Hab. —— ?

31. Mitra delicata, A. Adams. *M. testâ ovato-fusiformi; spirâ aperturâ longiore; anfractibus planis; suturâ subcanaliculatâ, sordidè albâ, fasciis transversis duabus pallidis; longitudinaliter plicatâ, plicis angustis, acutis, crenulatis, interstitiis transversim clathratis, anfractu ultimo anticè angustato et recurvato; columellâ plicis quatuor; labro margine acuto, crenulato.*
Hab. Cape York, 8 fathoms (*Jukes*).
A species of great delicacy, both of colour and sculpture.

32. Mitra rufescens, A. Adams. *M. testâ ovato-fusiformi; spirâ acuminatâ, sordidè albâ, rufo variegatâ, cingillis transversis, acutis, subdistantibus, liris duabus intermediis, interstitiis longitudinaliter valdè sulcatis, sulcis subdistantibus; columellâ anticè tortuosâ, plicis quatuor obliquis instructâ; labro internè sulcato, margine crenato.*
Hab. China Seas.
This species, obtained during the voyage of H.M.S. Samarang, partakes of the same kind of sculpture as *M. annulata* and others, for which Swainson has formed a subgenus.

33. Mitra formosa, A. Adams. *M. testâ oblongo-fusiformi, albo rufoque eleganter variegatâ; spirâ acutâ; anfractibus* 8, *rotundis, ad suturas subangulatis, cingillis transversis nodulosis ornatâ, nodulis subquadratis, in seriebus regularibus; aperturâ spirâ breviore; columellâ plicis quatuor; labro acuto, margine crenato.*
Hab. Marquesas (*Rohr*).
A very handsome species, entirely covered with close-set granules arranged in transverse rows.

34. Mitra sacerdotalis, A. Adams. *M. testâ oblongo-fusiformi; spirâ acuminatâ; anfractibus novem, subplanulatis; fulvâ, lineis fuscis transversis ornatâ, prope suturas albidâ, rufo maculosâ; lævi, sulcis distantibus, transversis insculptâ; anfractu ultimo basi recurvatâ; aperturâ spiræ dimidium æquante, recurvatâ et anticè truncatâ; columellâ plicis quatuor, obliquis; labro albo, acuto, anticè rotundato.*
Hab. Australia.
A fine species of a peculiar character, both as regards form, colour and sculpture.

35. Mitra macrospira, A. Adams. *M. testâ pyramidali-turritâ; spirâ valdè productâ, albidâ, maculis rufis irregularibus ornatâ; anfractibus planis, longitudinaliter costellatâ, costellis lævibus subconfertis, interstitiis clathrato-punctatis; anfractu ultimo anticè*

angustato, basi subrecurvo; columellâ plicis quinque; labro intus lirato, margine acuto, anticè producto subangulato.

Hab. ——?

A whitish species with a produced acuminate spire, and the short aperture with the base narrowed; the outer lip dilated anteriorly.

36. Mitra bellula, A. Adams. *M. testâ oblongo-fusiformi, albâ, nitidâ, maculis rufis moniliformibus ad suturas ornatâ; transversim sulcatâ; anfractibus planis, supremis cancellatis; aperturâ angustâ, anticè productâ, contortâ, et recurvâ; columellâ plicis quatuor instructâ.*

Hab. Isle of Capul, on the reefs, low water.

A small, transversely grooved, polished species, with a necklace-like row of reddish spots near the sutures.

37. Mitra echinata, A. Adams. *M. testâ fusiformi-turritâ; spirâ acuminatâ, albido-carneolâ, ad apicem rufescente, ad basin fasciâ latâ transversâ rufescenti ornatâ; anfractibus planis, longitudinaliter costatâ, costis prominentibus, prope suturas echinato-nodulosis, et infernè subnodosis, interstitiis sulcato-clathratis; labro intus lirato; columellâ plicis quatuor instructâ.*

Hab. ——?

38. Mitra scitula, A. Adams. *M. testâ fusiformi-turritâ; spirâ acuminatâ, anfractibus planiusculis, carneolâ; punctis rufescentibus sparsim pictâ; longitudinaliter costatâ, costis undulatis, lævibus, subdistantibus; interstitiis valdè clathratis; aperturâ anticè angustatâ, basi subrecurvâ; columellâ plicis quatuor instructâ.*

Hab. China Seas.

A small, turreted, light-coloured species, with undulating ribs and clathrated interstices.

39. Mitra marmorea, A. Adams. *M. testâ fusiformi-turritâ; spirâ acuminatâ; anfractibus planiusculis; olivaceâ, rufo-fuscâ marmoratâ, longitudinaliter costatâ, costis lævibus, crassis, supernè subnodosis; interstitiis transversim exaratis; columellâ plicis quinque; basi subcontortâ et recurvâ.*

Hab. Tambay, Isle of Negros, coarse sand, 10 fathoms.

Greenish, marbled with fuscous; ribs flat and broad; interstices with transverse engraved lines.

40. Mitra turricula, A. Adams. *M. testâ fusiformi-turritâ, albâ, carneo sparsim pictâ, anfractibus supernè angulatis; longitudinaliter costatâ, costis crassis, lævibus, distantibus, supra nodosis, interstitiis sulcato-clathratis; aperturâ spiram æquante; columellâ plicis quatuor, supremis duabus duplicatis; basi vix recurvâ.*

Hab. ——?

A small, elegant, turreted species, with smooth, thick ribs, and the interstices punctate-clathrate.

41. Mitra pallida, A. Adams. *M. testâ turrito-fusiformi;*

spirâ productâ, acuminatâ; anfractibus convexiusculis; albidâ, sparsim rufo-fusco pictâ, longitudinaliter costatâ, costis nodulosis, interstitiis clathrato-punctatis; aperturâ brevi, anticè angustatâ, basi productâ, tortuosâ et recurvâ; columellâ quadriplicatâ.

Hab. Marquesas.

A delicate, small, pale species, with scattered red-brown blotches, and with the interstices between the ribs clathrate-punctate.

42. Mitra Jukesii, A. Adams. *M. testâ ovato-fusiformi; spirâ acutâ, aperturæ dimidium æquante; anfractibus planis, prope suturas angulatis; albidâ, fasciis castaneis transversis ornatâ; transversim sulcatâ, sulcis, prope suturas, profundioribus; longitudinaliter plicatâ, plicis obtusis, distantibus, prope suturas nodulosis; columellâ plicis quatuor instructâ; labro intus lævi.*

Hab. North Australia (*Jukes*).

This species is intermediate between *M. corrugata* and *M. vulpecula*, but is distinct from both.

43. Mitra creniplicata, A. Adams. *M. testâ ovato-fusiformi; spirâ acuminatâ; anfractibus planulatis; brunneâ, longitudinaliter plicatâ, plicis crenatis tenuibus; transversim liratâ, liris æqualibus, confertis, nodulosis ad plicas; aperturâ spiram æquante; labio posticè calloso, anticè dilatato; columellâ plicis quatuor instructâ; labro intus dentato-lirato, margine incrassato.*

Hab. ——?

This species belongs to the group named by Mr. Gray *Zierliana*.

44. Mitra crenilabris, A. Adams. *M. testâ fusiformi; spirâ aperturam æquante; anfractibus planis; fulvâ, longitudinaliter substriatâ, transversim sulcatâ; aperturâ oblongâ, anticè dilatatâ; columellâ plicis quatuor, anticè incurvatâ; labro, in medio, recto, margine crenato et incrassato.*

Hab. ——?

This *Mitra* resembles in many particulars *M. fulva*, Reeve, but in all the specimens I have seen the outer lip is thin and smooth in that species.

45. Mitra castanea, A. Adams. *M. testâ ovato-fusiformi; spirâ productâ; anfractibus rotundatis; castaneâ, nitidâ, transversim punctato-striatâ; aperturâ quàm spira breviore, anticè dilatatâ; columellâ plicis quinque.*

Hab. ——?

This species most closely resembles *M. badia*, Reeve, but the whorls are rounded, and it differs in other particulars.

46. Mitra dichroma, A. Adams. *M. testâ ovato-fusiformi; spirâ acuminatâ; anfractibus planis; suturâ canaliculatâ, anticè castaneo-fuscâ, posticè albidâ; longitudinaliter substriatâ, transversim sulcatâ, sulcis anticè profundis, aperturâ anticè dilatatâ; columellâ plicis quinque instructâ, anticè productâ; labro intus lirato, margine crenulato.*

Hab. ——?

47. MITRA DEALBATA, A. Adams. *M. testâ ovato-fusiformi; spirâ apice cancellato; anfractibus planulatis; suturâ profundâ, albâ, transversim sulcatâ, sulcis distantibus; aperturâ oblongâ, anticè dilatatâ; columellâ posticè excavatâ; plicis sex; labro anticè dilatato, intus lirato.*

Hab. ——?

This species somewhat resembles *M. crenilabris* in form, but it is much more slender, and the sculpture is different.

48. MITRA NODULIFERA, A. Adams. *M. testâ turritâ, fusiformi; spirâ quàm apertura longiore; anfractibus, prope suturas, angulatis; albidâ, longitudinaliter plicatâ, plicis, ad suturas, nodulosis, prominentibus, distantibus; transversim liratâ, interstitiis longitudinaliter striatis; aperturâ intus fulvâ, posticè angulatâ; columellâ plicis quatuor; labro margine flexuoso.*

Hab. ——?

A small species, somewhat resembling *M. cymelium*, Reeve, but without the transverse black lines.

49. MITRA MARIÆ, A. Adams. *M. testâ ovato-conicâ; spirâ acuminatâ; anfractibus planis, cingulis tribus, transversis, acutis, elevatis, interstitiis longitudinaliter profundè sulcatis, instructis; posticè albâ, anticè hepaticâ, reticulationibus albis punctisque rufo-fuscis, ornatâ; anfractu ultimo, sulcis transversis, interstitiis simplicibus; columellâ plicis quinque instructâ; labro intus sulcato, margine crenulato.*

Hab. Eastern Seas.

Somewhat like *M. incisa*, but of very different form and colour.

50. MITRA PUSILLA, A. Adams. *M. testâ ovato-fusiformi; spirâ turritâ, elongatâ; anfractibus subrotundatis; albidâ, fasciâ latâ transversâ, carneolâ, anticè ornatâ; longitudinaliter costatâ, costis regularibus, æqualibus, subconfertis, interstitiis transversim valdè sulcatis; aperturâ brevi; columellâ plicis quatuor.*

Hab. ——?

A small species, with a single, transverse, faint pink band at the fore part of the last whorl.

51. MITRA COLUMBELLINA, A. Adams. *M. testâ ovato-fusiformi; spirâ brevi, acutâ; anfractibus subrotundatis, albo castaneoque concinnè pictâ, transversim evanidè sulcatâ; aperturâ ovato-oblongâ, anticè dilatatâ; columellâ plicis quatuor; labro intus lævi.*

Hab. ——?

This species is very prettily painted with white and dark chestnut-brown, and in form somewhat resembles a *Columbella*.

52. MITRA PHILIPPINARUM, A. Adams. *M. testâ ovato-fusiformi; spirâ brevi, acuminatâ; anfractibus planulatis, cinereâ, flammulis rufo-fuscis, longitudinalibus, variegatâ; transversim sulcatâ, sulcis regularibus, subdistantibus, profundis; aperturâ lineari-oblongâ, intus fuscâ; columellâ plicis sex; labro margine albo, crenato.*

Hab. Philippines.

This species is figured in Mr. Reeve's Monograph as *M. flammea* of Quoy, the original type of which, however, Mr. Cuming possesses, and it is entirely different.

May 27, 1851.—W. Yarrell, Esq., V.P.L.S., in the Chair.

The following communications were received and read:—

1. Notice of the Birds of Madeira, in a letter addressed to the Secretary.
By Edward Vernon Harcourt, Esq.

Sir,—According to your request, I send you a short account of the birds that breed in Madeira, together with a list of those that visit the island.

The birds of Madeira are less numerous than might be expected in so genial a climate, and most of them are merely varieties, where they differ from European species.

The birds that breed in Madeira are these:—

	Latin Name.	*English Name.*	*Portuguese Name.*
1.	Falco Tinnunculus, *Linn.*	Kestrel.	Francelho.
2.	—— Buteo, *Linn.*	Buzzard.	Manta.
3.	Strix flammea, *Linn.*	Barn Owl.	Coruja.
4.	Turdus Merula, *Linn.*	Blackbird.	Mérlo-preto.
5.	Sylvia Rubecula, *Lath.*	Redbreast.	Papinho.
6.	—— atricapilla, *Lath.*	Black-cap Warbler.	Tinto-Negro.
	(Curruca Heinekeni, *Jard.*)	Variety of the former.	Tinto-Negro de Capello.
7.	Curruca conspicillata, *Gould.*	Spectacle Warbler.	None.
8.	Regulus —— ?	—— ?	Abibe.
9.	Motacilla boarula, *Linn.*	Grey Wagtail.	Lavandeira amarella.
10.	Anthus pratensis, *Bechst.*	Meadow Pipit.	Corre de Caminho.
11.	Fringilla butyracea, *Linn.*	Green or Wild Canary.	Canario.
12.	—— Carduelis, *Linn.*	Goldfinch.	Pinta Silva.
13.	—— Petronia, *Linn.*	Ring Sparrow.	Pardao.
14.	—— Tintillon, *Webb & Berthelot.*	Buff-breasted Chaffinch.	Tentilhao.
15.	—— cannabina, *Linn.*	Greater Redpole or Linnet.	Tinto roxo.
16.	Cypselus unicolor, *Jard.*	Lesser Swift.	Andorinha da Serra.
17.	—— murarius, *Temm.*	Common Swift.	—— do Mar.
18.	Columba Trocaz, *Hein.*	Long-toed Wood-Pigeon.	Trocaz.
19.	—— Palumbus, *Linn.*	Ring-dove.	Pombo.
20.	—— Livia, *Briss.*	Rock-pigeon.	Pombinho.
21.	Perdix rubra, *Briss.*	Red-legged Partridge.	Perdix.
22.	—— Coturnix, *Lath.*	Quail.	Cordonez.
23.	Scolopax Rusticola, *Linn.*	Woodcock.	Gallinhola.
24.	Sterna Hirundo, *Linn.*	Tern.	Garajao.
25.	Larus argentatus, *Brunn.*	Herring Gull.	Gaio, Guivata (after 3rd aut. moult).

Latin Name.	*English Name.*	*Portuguese Name.*
26. Procellaria Puffinus, *Linn.*	Cinereous Shearwater.	Cagarra.
27. —— Anglorum, *Temm.*	Manks Shearwater.	Boeiro.
28. —— obscura, *Gmel.*	Dusky Petrel.	Pintainho.
29. —— anginho, *Hein.*	Angel Petrel.	Anginho.
29. —— Bulwerii, *Jard.*	Bulwer's Petrel.	Anginho.
30. ——?	——?	Roque de Castro.

The Kestrels are very numerous and very tame, perching on the roofs of houses, from whence they dart frequently at canary-birds hanging in their reed cages outside the windows, and they generally succeed in securing their prey; they live principally on lizards, grasshoppers, and mice.

The Buzzard is seldom seen about the town, but confines his flights to the highest mountains, feeding on small birds, insects, and reptiles.

The Barn Owl inhabits the ravines in small numbers; it is a little darker than the British Owl. It may be remarked that all the birds of Madeira are darker than their European brethren.

The Redbreast is very common; it is frequently caged, and seems to flourish in captivity.

The Blackbird, which in some parts is very plentiful, does not differ from the English bird.

The Black-cap Warbler, which is here the most domestic songster, has been sometimes called the Madeira Nightingale; there is a fulness in its warble which in a degree justifies such praise. A Madeiran variety of this bird has been described by Sir William Jardine* as a new species, under the name of *Curruca Heinekeni*; Dr. Heineken, however, in his paper on the subject in the 'Zoological Journal,' No. xvii. Art. xvii., disproves the supposition of its being a distinct species, and I am able to confirm the view that Dr. Heineken takes of it. The popular belief amongst the natives is, that where the nest of a "Tinto Negro" contains five eggs, the fifth always turns out a "Tinto Negro de Capello." The variety is much prized; for where you could buy a common "Tinto Negro" for sixpence or a shilling, you would be asked eight or ten shillings for a "Tinto Negro de Capello." The size of the two birds is precisely the same in all particulars; the chief difference consists in the black cap in the variety being extended to the shoulders, and I have sometimes seen the black extended over all the under parts: the under parts are generally much the same as those of the common female Black-cap, and the upper parts as those of the common male.

The Wren is one of the prettiest feathered inhabitants of Madeira; it lives amongst the laurel forests, in the less frequented parts of the island. It seems intermediate between the Gold and Fire-crested Wrens of Britain, and is a little larger and brighter than either.

The Spectacle Warbler is very locally distributed; it is found in brakes and bushes in some of the unfrequented parts.

The Grey Wagtail is very common, frequenting the cisterns attached to houses, as well as the streams; where, from its familiar habits

* Edinb. Journ. of Nat. and Geog. Science, Jan. 1830, vol. i. p. 243.

amongst the washerwomen, it has been admitted in Madeiran phraseology into the ranks of the sisterhood, under the title of "Lavandeira."

The Meadow Pipit is plentifully found on the cliffs and fields near the sea, and on the serras.

The Green Canary is the original stock of the bird so well known to us as the Yellow Canary; it flies about in large flocks, with linnets and other birds, and is easily distinguished by its song, which is the same as that of the captive variety. The price of a good singing canary, either in Madeira or the Canary islands, varies from five to nine shillings, so that in fact it may be bought much cheaper in London. This bird has been admirably described by Dr. Heineken, in the 'Zoological Journal,' No. xvii. Art. xvii.

The Goldfinch is very common, and differs in no respect from our own.

The Ring Sparrow here takes the place, in a way, of our House Sparrow: it is universal; on the bleak serras, near houses, on the rocks by the sea; there is no place that it does not frequent. It differs thus in habits, though in nothing else, from the Ring Sparrow of Europe.

The Chaffinch of Madeira is nearly identical with the bird figured, under the name of "*Fringilla Tintillon*," in Webb and Berthelot's work on the Canary islands.

The Greater Redpole is very abundantly met with; it differs from the English Linnet in retaining its carmine colouring through the year.

The Lesser Swift is mentioned in Brewster's 'Journal,' by Dr. Heineken, under the title of "Black-chinned Swift." This property is however by no means general amongst the species: I have several in my possession with the chin fully as white as that of the common Swift. One of the chief differences is in size, the '*unicolor*' being much the smallest. The tail is forked about an inch and a half, and the plumage is rather darker than that of the common Swift.

The common Swift is not quite so plentiful as the Lesser Swift. Both species remain in the island throughout the year; their nests are built in the cliffs; their habits vary from those of Swifts in England; here they seem to take the place of the Swallow, hunting and skimming along the ground in a manner that would appear very degrading to their northern brethren.

The Ring-dove appears to be rather larger than the English bird; in other respects it is similar. It lives in the forests on the north side of the island.

The Long-toed Wood Pigeon has been described by Dr. Heineken, in 'Brewster's Journal,' under the name of "*Columba Trocaz*;" it is about an inch longer than the Madeiran Ring-dove; one of its chief peculiarities, and which seems to have escaped observation, is the great length of its centre toe, being more than an inch longer than that of the Ring-dove; it has a silvery ring all round its neck; it is darker in its general plumage than the Ring-dove, and is excellent eating. It inhabits the forests on the north side of the island, feeding upon grasses and the acorns of the laurel-trees.

The Rock Pigeon inhabits the sea cliffs, and rocks in the ravines

all over the island. There is a variety here which is darker in its plumage and in the colour of its feet than the common Rock Pigeon.

The Red-legged Partridge is shot on the serras.

The Quail is more plentiful than the Partridge, and approaches nearer to the habitations of man; it pairs, laying about sixteen eggs, and has three or four broods in the season.

The Woodcock is found chiefly in the west, and on the Paul da Serra, sometimes plentifully. It is a large bird, but I think of inferior flavour; it breeds in the island, and is met with throughout the year.

The Tern appears chiefly at the Dezerta islands and at Point São Lourenço.

The Herring Gull is common everywhere; Dr. Renton says it is quicker by some months in obtaining its mature plumage than with us.

The Cinereous Shearwater breeds plentifully on the Dezerta islands; its cry, whether on the wing or on shore, is very remarkable; the natives salt it and consider it eatable.

The Manks Shearwater is also very plentiful at the Dezertas; it is easily distinguished from the Dusky Petrel, which is another inhabitant of the Dezertas, by its superior size, and by the colour of its feet. In the Dusky Petrel the feet are bluish ash-colour, and in the Manks Shearwater flesh-colour; in the Dusky Petrel all the secretions are green, and in the Manks Shearwater yellow. The Dusky Petrel is a very tame bird, and will live upon almost anything; it runs along the ground on its belly, and uses its curious-shaped bill in climbing up the rocks.

The Angel Petrel of Heineken has the tail slightly forked, and differs from the other smaller Petrels in having no white about the rump or flanks; it is entirely uniform black; it is very common on the Dezerta islands; when approached it emits a highly offensive matter.

The Bulwer's Petrel, as described by Sir Wm. Jardine *, I never saw at Madeira, nor have I ever met with any one that has seen it there. Sir Wm. Jardine says, "it is easily distinguished from any other, by having the two centre tail-feathers elongated, as in the genus *Lestris*, and not even or forked, like the other Petrels." It is probably identical with the Angel Petrel.

There is another Petrel, called by the natives "Roque de Castro," pronounced "Roque de Crasto," which differs from any I have ever seen described; it approaches perhaps nearer to Leach's Petrel than any other, though the shape of the bill alone is sufficient to separate it from that species. It is common on the Dezerta islands, where it breeds, though it is by no means so abundant as the Angel Petrel.

* Sir W. Jardine on the Birds of Madeira, 'Edinb. Journ. of Nat. and Geog. Science,' Jan. 1830, p. 245, and 'Illustrations of Ornithology,' by Jardine and Selby.

The following is a list of the stragglers found in Madeira:—

	Latin Name.	*English Name.*	*Authority* †.
31.	Cathartes percnopterus, *Temm.*	Egyptian Vulture.	* * *
32.	Falco nisus, *Linn.*	Sparrow Hawk.	* * *
33.	Corvus corax, *Linn.*	Raven.	* * *
34.	—— corone, *Linn.*	Carrion Crow.	Mr. Lowe.
35.	Oriolus galbula, *Linn.*	Golden Oriole.	* * *
36.	Sturnus vulgaris, *Linn.*	Common Starling.	* * *
37.	Turdus iliacus, *Linn.*	Redwing.	Mr. Lowe.
38.	—— musicus, *Linn.*	Common Thrush.	Mr. Penfold.
39.	Sylvia hortensis, *Lath.*	Greater Petty-chaps.	Mr. Penfold.
40.	Troglodytes europæus, *Selb.*	Common Wren.	Mr. Lowe.
41.	Motacilla alba, *Linn.*	Pied Wagtail.	* * *
42.	Alauda arvensis, *Linn.*	Skylark.	Mr. Lowe.
43.	Fringilla chloris, *Linn.*	Green Grosbeak.	* * *
44.	—— domestica, *Linn.*	Common Sparrow.	Mr. Penfold.
45.	Cuculus canorus, *Linn.*	Cuckoo.	* * *
46.	Musophaga africana, *Temm.*	African Bee-eater.	Mr. Lowe.
47.	Upupa epops, *Linn.*	Hoopoe.	* * *
48.	Merops apiaster, *Linn.*	Bee-eater.	Mr. Lowe.
49.	Alcedo ispida, *Linn.*	King-fisher.	Mr. Lowe.
50.	Hirundo urbica, *Linn.*	House Martin.	* * *
51.	—— rustica, *Linn.*	Chimney Swallow.	* * *
52.	—— riparia, *Linn.*	Bank Martin.	Doubtful.
53.	Caprimulgus europæus, *Linn.*	European Goatsucker.	Mr. Hinton.
54.	Columba œnas, *Linn.*	Stock-dove.	Mr. Lowe.
55.	—— Turtur, *Linn.*	Turtle-dove.	* * *
56.	Œdicnemus crepitans, *Temm.*	Thick-knee.	Mr. Lowe.
57.	Calidris arenaria, *Ill.*	Sanderling.	Mr. Lowe.
58.	Vanellus cristatus, *Meyer.*	Crested Lapwing.	* * *
59.	Charadrius hiaticula, *Linn.*	Ringed Plover.	Mr. Lowe.
60.	—— pluvialis.	Golden Plover.	Mr. Hewitt.
61.	Strepsilas interpres, *Leach.*	Turnstone.	Mr. Lowe.
62.	Ciconia nigra, *Temm.*	Black Stork.	Mr. Lowe.
63.	? Ardea cinerea.	Common Heron.	* * *
64.	Ardea russata, *Wagler.*	Buff-backed Heron.	* * *
65.	—— purpurea, *Linn.*	Purple Heron.	* * *
66.	—— minuta, *Linn.*	Little Bittern.	* * *
67.	—— stellaris, *Linn.*	Common Bittern.	Mr. Lowe.
68.	—— nycticorax, *Linn.*	Night Heron.	* * *
69.	Limosa melanura, *Leisler.*	Black-tailed Godwit.	* * *
70.	Numenius arquata, *Lath.*	Common Curlew.	Mr. Hinton.
71.	—— phæopus, *Temm.*	Whimbrel.	Mr. Lowe.
72.	Tringa pugnax, *Linn.*	Ruff.	* * *
73.	—— subarquata, *Temm.*	Pigmy Curlew.	Mr. Lowe.
74.	—— variabilis, *Meyer.*	Dunlin.	* * *
75.	—— cinerea, *Temm.*	Knot.	Mr. Lowe.
76.	Totanus hypoleucos.	Sandpiper.	* * *
77.	—— glottis, *Bechst.*	Greenshank.	* * *
78.	Scolopax gallinago, *Linn.*	Common Snipe.	Mr. Hinton.
79.	—— major, *Temm.*	Great Snipe.	* * *
80.	Crex Baillonii, *Temm.*	Baillon's Crake.	* * *
81.	Gallinula chloropus, *Lath.*	Gallinule.	* * *

† Where there are stars it is on my own authority.

Latin Name.	*English Name.*	*Authority*†.
82. Ortygometra crex, *Temm.*	Land-rail.	Mr. Lowe.
83. Fulica atra, *Linn.*	Coot.	* * *
84. Anser segetum, *Steph.*	Bean Goose.	* * *
85. Mareca penelope, *Selb.*	Wigeon.	Mr. Penfold.
86. Anas crecca, *Linn.*	Teal.	* * *
87. —— boschas, *Linn.*	Mallard.	Mr. Penfold.
88. Sterna nigra, *Linn.*	Black Tern.	Mr. Lowe.
89. —— Dougallii, *Mont.*	Roseate Tern.	Sir W. Jardine.
90. Larus tridactylus, *Lath.*	Kittiwake.	* * *
91. Lestris cataractes, *Temm.*	Skua.	* * *
92. Colymbus glacialis, *Linn.*	Northern Diver.	* * *
93. Sula alba, *Temm.*	Gannet.	Mr. Lowe.
94. Procellaria Leachii, *Temm.*	Leach's Petrel.	Sir W. Jardine.
95. —— pelagica, *Linn.*	Stormy Petrel.	Doubtful.

I have the honour to remain, Sir,

Yours, &c.,

EDWARD VERNON HARCOURT.

BOTANICAL SOCIETY OF EDINBURGH.

May 12, 1853.—Professor Balfour, President, in the Chair.

The following papers were read:—

1. "On the Soap Beans of China," by Dr. Macgowan of Ningpo. This paper contained a popular description, chiefly derived from Chinese authorities, of two species of *Cæsalpinia*, which furnish the Soap Bean and the Plump Soap Bean of the Chinese. The Beans have marked saponaceous qualities, and are used as detergents, for cleaning silver vessels, &c.

2. "On the Flora of the Island of Arran," by Dr. Balfour. The author noticed the plants which occur in different districts, in connexion with the rocks. He mentioned that he had observed between 500 and 600 Phanerogamous plants, and 27 Ferns and Equiseta.

3. "On the Colorific properties of the Lichens. Part III. The Manufacture of the Lichen-dyes," by W. Lauder Lindsay, M.D. The author detailed the various processes of manufacture as carried on in different countries, on the large scale (by the manufacturer) and small scale (by the peasant), with the principles on which these are severally founded.

June 9.—Professor Balfour, President, in the Chair.

Dr. Balfour stated that some of the Palms in the Botanic Garden had sent their fronds through the roof of the Palm-House, and that unless measures were taken immediately for making an addition to the house, he would be under the necessity of destroying some of the finest Palms in Britain.

The following are the measurements of some of them. In giving

† Where there are stars it is on my own authority.

the height, the leafy part at the top of the caudex is included, along with the tub in which the plant is growing:—

Acrocomia aculeata, 38 feet.
Areca triandra, 19 ,,
Caryota urens, 43 ,,
The frond is 4 feet 9 inches beyond the roof.
Chamærops humilis var. elata, 20 feet.
Cocos nucifera . . 18 ,,
Euterpe montana . . 38 ,,
Frond about 2 feet beyond the roof.
Livistona chinensis, 40 feet.
Fronds bent down by the roof of the house.
Sagus Rumphii, 43 feet.
Fronds about 10 inches beyond the roof.
Seaforthia elegans, 22 feet.

Several of them are between fifty and sixty years old.

Dr. Balfour gave an account of a botanical trip to Ireland in August 1852 with some of his pupils.

MISCELLANEOUS.

On the Fecundation of the Fucaceæ. By M. Gustave Thuret.

The physiological functions of the antheridia in the higher Cryptogamia appear to be now pretty well established. It is no longer doubted that they are fecundating organs, and that the antherozoids which they contain are the immediate agents of fecundation, although the action of these upon the female organ or archegonium has not yet been observed.

But as regards the lowest Cryptogamia (Algæ, Fungi, Lichens) the question is much less advanced. The existence of antheridia in these vegetables is a recent discovery, which careful researches will probably extend to all the families of this vast group, but which in the author's opinion cannot be established with certainty until the fecundating power of these organs upon the reproductive apparatus shall be demonstrated.

The author availed himself of his stay at Cherbourg to endeavour to resolve this question as regards the organs designated by M. Decaisne and himself as the antheridia of the Fucaceæ. He considers that the results of his researches furnish the first direct proof of the existence of true sexuality in the lower Cryptogamia.

With this view he has studied the phænomena presented by artificial impregnation. Several species of Fucaceæ are dicœcious; when these plants are placed for some time in a damp atmosphere, the spores and the antheridia are pushed out on the surface of the fronds in great numbers; they are then easily collected and deposited in vessels filled with sea-water, or simply in a drop of water on a slip of glass which is protected from evaporation.

When these organs are kept in separate vessels, the following phænomena are observed. The antheridia immediately emit their antherozoïds, which move about with the greatest vivacity; these movements are frequently continued till the next day, diminishing gradually in intensity; on the third day decomposition commences. The spores remain for about a week without sensible alteration; they then also decompose without further development. Sometimes phænomena resembling germination are exhibited; some of them emit irregular prolongations, but no septa are formed; the evolution of the spores proceeds no further; they become decomposed like the others. In fact, germination never takes place in spores which are deprived of the contact of the antherozoïds.

But when the spores and the antheridia are mixed together, the spore becomes invested with a very distinct membrane in the course of a day or two, a septum is formed which divides the spore into two hemispheres, and a sensible elongation begins to appear on a point of the circumference. The development of the young plant then proceeds rapidly; the septa become more numerous, the elongation increases, and in about ten days the spore is converted into a small ovoid, cellular mass, of a brown colour, supported on a transparent radicle.

If the experiment has been performed on a slip of glass kept constantly near a window in the same position, it will be seen that nearly all the radicles are turned towards the interior of the room, or from the light.

The fecundating action of the antherozoïds upon the spores is therefore an incontestable fact. When they are in considerable quantity, they frequently attach themselves to the spores, crawl in a manner upon their surface, and communicate to them, by means of their vibratile cilia, a rotatory movement which is often very rapid. Nothing is more curious than the appearance of these large brownish spheres rolling in all directions amongst the crowds of antherozoïds which surround them. This phænomenon, however, does not appear to be necessary for the fecundation of the spores. When all movement has ceased and germination has commenced, the remains of decomposed antherozoïds frequently surround the spore without being immediately in contact with it; a layer of mucilage separates them from the membrane of the spore and forms a transparent halo around it.

The author endeavoured to fecundate the spores of *Ozothallia vulgaris* (*Fucus nodosus*, Linn.) with the antherozoïds of *Fucus serratus* and *vesiculosus*, and *vice versâ*. But although the spores and antherozoïds of these three species present the most complete resemblance, and although the antherozoïds attach themselves in great numbers to the spores, causing them to move with great vivacity, no germination took place. Nor did he succeed in fecundating the spores of *Fucus serratus* with the antherozoïds of *Fucus vesiculosus*. But on reversing this experiment, some of the spores of the *F. vesiculosus* germinated. He does not venture to conclude from this that a hybrid fecundation is possible, but nevertheless calls attention to the

fact, that whilst the *Ozothallia* and the *Fucus serratus* are very constant in form, the *F. vesiculosus* is extremely polymorphous.

In the higher Cryptogamia the phænomenon of fecundation presents two principal modifications. In the Mosses and Characeæ it takes place in adult plants, and appears to be necessary for the formation of the reproductive bodies; it must consequently be repeated every time that the plant fructifies, and in this respect approaches the process in the phanerogamous plants. In the Equisetaceæ, the Ferns, the Lycopodiaceæ, and the Rhizocarpeæ, fecundation takes place some time after the germination of the spore; its result is the development of the frond which will fructify every year without fresh fecundation. The Fucaceæ present a third modification of the phænomenon, which resembles the second rather than the first, and which has perhaps still more analogy with what takes place in the case of animals. Here it is upon the spore itself that the fecundating action of the antherozoïds is exerted, and it is only in consequence of this contact that the spore is developed into a frond capable of fructifying every year without fresh fecundation.—*Comptes Rendus*, April 25, 1853.

TIME OF SPAWNING OF BRITISH CRUSTACEA.

To the Editors of the Annals of Natural History.

Weymouth, June 18, 1853.

Gentlemen,—I enclose you an addition to my list of the "Time of Spawning of British Crustacea" which appeared in the 'Annals of Nat. Hist.' vol. viii. p. 501.

I wish to draw the attention of your readers to an error in that paper, in which *Crangon bispinosus* is enumerated instead of *Crangon trispinosus*. I have not yet been able to obtain *C. bispinosus*. I am at a loss to conceive how this error could have occurred, as my notes are correct.

I have now succeeded in fixing the dates of carrying spawn of *thirty-eight* species of British Crustacea, and I have myself obtained at this place fifty-four species, and fully expect to add to that number.

Amongst my latest captures are *Crangon spinosus*, *Hippolyte Whitei* (mihi), *Mysis chameleon*, *Mysis Griffithsiæ*, and one or two species I cannot at present make out.

My dredger is a very clever fellow, and would be pleased to supply anything he might obtain when dredging.

I am, Gentlemen, yours obediently,

William Thompson.

Species.	Date when found carrying ova.	General Remarks.
Achæus Cranchii	Aug. 18, 1852.	I dredged two in six fathoms, shingle and weedy bottom: one female had two single ova; they are of a deepish yellow colour.

Species:	Date when found carrying ova.	General Remarks.
Crangon fasciatus.....	June 13, 1853.	I obtained two; one of which was in spawn: ova of a rich brown: this individual was of a darker colour than the other. Caught in three fathoms, sand and shingle.
Crangon spinosus.....	June 15, 1853.	Two; both in spawn: ova of a dirty white tinged with green. The colour of this shrimp when first caught is very beautiful; it is blotched with claret colour. Dredged in the same locality as the last species.
Crangon sculptus	May 4, 1853.	Three in spawn: ova of a light drab colour. Dredged in six fathoms, shingly bottom.
Crangon trispinosus...	June 9 & 13, 1853.	I obtained several, most of them being in spawn: the ova are of a light sea-green colour. This is the most numerous of the rarer shrimps. Two to four fathoms, sandy bottom.
Crangon vulgaris	January to July every year.	This species is in spawn all the summer months: I believe they deposit their ova in the month of June: the ova are drab or dirty white. Sandy bottom, from low water to four fathoms.
Cancer Pagurus	March 12, 1853.	In spawn: ova of an orange colour. Caught in a trawl.
Carcinas Mænas	Nov. 23, 1851. March 1, 1853.	In spawn: ova orange-brown.
Eurynome aspera	June 6, 1852.	Two, in spawn: the ova are small, of a lovely bright red transparent coral colour. Dredged in twelve fathoms water, shingly bottom.
Hippolyte Cranchii ...	Aug. 18, 1852.	Several in spawn, in five to seven fathoms water, weedy bottom.
Inachus dorynchus ...	Aug. 18, 1852. May 30, 1853.	I dredged four; one of them carried ova in very small quantity,—the greater portion had evidently been deposited. Those caught in May 30, 1853, carried a quantity of spawn: the ova are large and of an orange-brown colour: the colour of the animal is dingy purple, brighter on the fore part of the carapace. Caught in weedy bottom, six fathoms.

Species.	Date when found carrying ova.	General Remarks.
Stenorhynchus phalangium.	Aug. 18, 1852. May 30, 1853.	In the first, very few ova were left in the purse; in those caught in May 1853, the spawn was so plentiful that the abdomen was thrown back on a plane with the carapace.
Stenorhynchus tenuirostris.	May 30, 1853.	In spawn: ova of a light orange-brown colour: the abdomen in consequence of the large quantity of ova was thrown back on a level with the carapace. This species when alive is of a lovely pink or puce colour. Weedy bottom, three fathoms.
Hippolyte Whitei (mihi)*.	June 14, 1853.	Several in spawn: the ova are palish yellow, but much hidden by the scales of the abdomen. The prevailing colour of this species is meadow green, with (whilst alive) a white band running down the centre of the back. In each there were two teeth on the under edge of the rostrum. Weedy bottom and stones, four to six fathoms.
Hippolyte Thompsoni.	May 4, 1853.	Dredged some in spawn: the ova are of a dirty green. Rocky and weedy bottom, three to five fathoms.
Palæmon Leachii.....	June 8, 1853.	This is now in spawn; some few have deposited their ova, which are of a brownish drab colour.
Palæmon serratus.....	June 1853.	All in spawn; it will be deposited before the middle of July.
Mysis vulgaris	June 14, 1853.	In spawn: ova of a brownish colour.
Mysis Griffithsiæ	June 14, 1853.	In spawn.

Experimental Researches on Vegetation. By M. Georges Ville.

After stating that it has often been asked if air, and especially azote, contributes to the nutrition of plants; and, as regards the latter, that this question has always been answered negatively, the author remarks it is however known that plants do not draw all their azote from the soil, the crops produced every year in manured land giving a greater proportion of azote than is contained in the soil itself. The question which he has proposed to himself for so-

* This new and beautiful species of *Hippolyte* I have named after Mr. Adam White of the British Museum. I have drawn up a specific description for the 'Annals' for August.—W. T.

lution is, whence then comes the excess of azote which the crops contain, and in a more general manner, the azote of plants, which the soil has not furnished? He divides his inquiry into the three following parts:—

First. Inquiry into and determination of the proportion of the ammonia contained in the air of the atmosphere.

Second. Is the azote of the air absorbed by plants?

Third. Influence on vegetation of ammonia added to the air.

1. The author remarks that since the observation of M. Théodore de Saussure, that the air is mixed with ammoniacal vapours, three attempts have been made to determine the proportion of ammonia in the air: a million of kilogrammes of the air, according to M. Gräyer, contain 0·333 kil. N^2H^3; according to Mr. Kemp 3·880 kil.; according to M. Frésenius, of the air of the day, 0·098 kil., and of night air, 0·169 kil. He states that he has shown the cause of these discrepancies, and proved that the quantity of ammonia contained in the air is 22·417 grms. for a million of kilogrammes of the air; and that the quantity oscillates between 17·14 grms. and 29·43 grms.

2. The author states that though the azote of the air is absorbed by plants, the ammonia of the air contributes nothing to this absorption. Not that ammonia is not an auxiliary of vegetation, but the air contains scarcely 0·0000000224, and in this proportion its effects are inappreciable. These conclusions are founded upon a great number of experiments in which the plants lived at the expense of the air without deriving any thing from the soil. For the present he confines himself to laying down these two conclusions:—1. The azote of the air is absorbed by plants, by the cereals, as by all others. 2. The ammonia of the atmosphere performs no appreciable part in the life of plants, when vegetation takes place in a limited atmosphere. After describing the apparatus by means of which he carried on his experiments on the vegetation of plants placed in a soil deprived of organic matter, and the manner in which the experiments were conducted, he adduces the results of these experiments in proof of the above conclusions.

3. With reference to the influence of ammonia on vegetation, the author states that, if ammonia be added to the air, vegetation becomes remarkably active. In the proportion of 4 ten-thousandths the influence of this gas shows itself at the end of eight or ten days, and from this time it manifests itself with a continually increasing intensity. The leaves, which at first were of a pale-green, assume a deeper and deeper tint, and for a time become almost black; their petals are long and upright, and their surface wide and shining. In short, when vegetation has arrived at its proper period the crop is found far beyond that of the same plants grown in pure air; and, weight for weight, they contain twice as much azote. Besides these general effects there are others which are more variable, which depend upon particular conditions, but which are equally worthy of interest. In fact, by means of ammonia we can not only stimulate

vegetation, but, further, we can modify its course, delay the action of certain functions, or enlarge the development and the modification of certain organs. The author further remarks, that if its use be ill-directed, it may cause accidents. Those which have occurred in the course of his experiments appear to him to throw an unexpected light upon the mechanism of the nutrition of plants. They have at least taught him at the expense of what care ammonia may become an auxiliary of vegetation. These experiments, which were made under the same conditions as those upon the absorption of azote, are then described, and their numerical results given.

To the conclusions already stated, the author adds that there are periods to be selected for the employment of ammonia, during which this gas produces different effects. If we commence its use when several months intervene before the flowering season of the plants, it produces no disturbance; they follow the ordinary course of their vegetation. If its use be commenced at the time of flowering, this function is stopped or delayed. The plant covers itself with leaves, and if the flowering takes place all the flowers are barren.—*Proc. Roy. Soc.* May 26, 1853.

On the Priority of the Discovery of the Mode of Action of the Pholades in the Perforation of Stones. By M. Vrolik.

The question of the perforation of rocks by Pholades, which has been brought before the Academy of Sciences, has given rise to a claim of priority put forward by Mr. Robertson, and since contested by M. Caillaud.

The Academy will not be displeased to learn that Professor Vrolik of Amsterdam has just shown that the fact of mechanical perforation by the valves, and as the result of the simple movement of the Pholades, without the assistance of any acid, was described more than seventy years ago by Léendert Bomme, a Director of the Commercial Company of Middelbourg. His memoir, in which he enters into many details respecting the œconomy of these animals, which in 1759 and 1760 threatened the destruction of the dykes of the island of Walcheren, was published in the Transactions of the Scientific Society of Flessingen.—*Comptes Rendus*, May 2, 1853.

On Sun Columns observed at Sandwick Manse, Orkney. By the Rev. C. Clouston.

May 18th. About 8 P.M. observed a mock sun having prismatic colours, on the N. side of the sun, with rays on the off side converging to a point. In about 15 minutes another of the same description, but fainter, appeared on the S. side of the sun, and a faint halo appeared over the sun, as if joining there. At sunset there was a faint sun pillar.

21st. At sunset another sun pillar seen.

23rd. A sun pillar seen tonight at 8 P.M., about 45 minutes before sunset, at first being a pale whitish beam, shooting up through the

clear blue sky, fully 15° high, and very slender, scarcely the diameter of the sun.

After the sun had set in a golden sky it became of a rosy hue, brighter and broader at some places than others, as if the brightest strata, or thin laminæ of the horizontal clouds, reflected the sun-beams most perfectly. It continued quite perpendicular, and about half-past 9 o'clock, or 45 minutes after sunset, vanished gradually—the last spot of it being 1 or 2 degrees above the horizon. About an hour afterwards, when the moon rose, a pillar of light also appeared over her, but fainter and shorter, and after 30 minutes when she had risen a little above the horizon, a similar pillar appeared below her, but they only extended about 3 or 4 diameters of the moon on each side, having her diameter as a base, and tapering away as they receded from her. This continued till 12 o'clock and probably much longer.

I am told that the sun pillar was again very beautiful before sunrise next morning, about 3 o'clock.

METEOROLOGICAL OBSERVATIONS FOR MAY 1853.

Chiswick.—May 1. Very fine. 2. Slight haze: fine: rain at night. 3. Constant rain. 4. Hazy. 5. Very fine. 6. Cloudy. 7. Overcast: cold rain. 8. Cloudy: overcast: clear. 9. Rain: boisterous. 10. Cloudy and boisterous. 11. Fine. 12. Fine: very clear. 13. Cloudy: rain. 14. Fine. 15. Fine: overcast. 16. Very fine. 17. Dry haze: clear and fine. 18. Fine. 19. Very fine. 20. Clear: slight frost at night. 21. Hazy: fine. 22. Clear and dry. 23. Clear: partially overcast at night. 24. Cloudless: windy: slightly overcast. 25. Very fine. 26. Very fine: clear at night. 27. Very fine: rather hazy: lightning at night: rain. 28, 29. Very fine. 30. Cloudy and fine. 31. Cloudy and cold.

Mean temperature of the month	51°·41
Mean temperature of May 1852	51 ·45
Mean temperature of May for the last twenty-seven years	53 ·95
Average amount of rain in May	1·77 inch.

Boston.—May 1, 2. Fine. 3, 4. Cloudy. 5. Fine. 6. Cloudy. 7. Cloudy: rain and snow A.M. 8. Cloudy. 9. Rain: rain A.M. 10. Rain: rain and hail A.M. and P.M. 11, 12. Fine. 13. Cloudy. 14, 15. Fine. 16. Cloudy. 17—28. Fine. 29. Cloudy: rain P.M. 30, 31. Cloudy.

Sandwick Manse, Orkney.—May 1. Bright A.M.: damp P.M. 2. Hazy A.M.: fog P.M. 3. Clear A.M.: clear, aurora P.M. 4. Bright A.M.: fog P.M. 5. Damp A.M. and P.M. 6. Cloudy, showers A.M.: sleet-showers, aurora P.M. 7. Snow-showers A.M.: sleet-showers, aurora P.M. 8. snow-showers A.M.: sleet-showers P.M. 9. Sleet-showers A.M.: snow-showers P.M. 10. Snow-showers A.M.: clear P.M. 11. Bright A.M.: clear P.M. 12, 13. Clear A.M.: clear, fine P.M. 14—17. Clear A.M. and P.M. 18, 19. Clear, fine A.M. and P.M. 20. Clear A.M. and P.M. 21. Bright, fine A.M.: clear, fine P.M. 22. Bright A.M.: clear, fine P.M. 23. Bright A.M.: sun pillar, clear, fine P.M. 24, 25. Bright, fine A.M.: clear, fine P.M. 26. Cloudy A.M. and P.M. 27. Clear A.M.: clear, fine P.M. 28, 29. Cloudy A.M. and P.M. 30. Bright A.M.: clear, fine P.M. 31. Bright, fine A.M.: clear, fine P.M.

Mean temperature of May for twenty-six previous years	47°·94
Mean temperature of May 1852	50 ·49
Mean temperature of this month	49 ·07
Average quantity of rain in May for seven previous years	1·68 inch.

Meteorological Observations made by Mr. Thompson *at the Garden of the Horticultural Society at* CHISWICK, *near London*; *by* Mr. Veall, *at* BOSTON; *and by the* Rev. C. Clouston, *at Sandwick Manse*, ORKNEY.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston. 8¾ a.m.	Orkney, Sandwick.		Chiswick.		Boston. 8½ a.m.	Orkney, Sandwick.		Chiswick. 1 p.m.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1853. May.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
1.	29·885	29·808	29·57	29·86	29·97	68	40	54	52	46	se.	se.	ese.	.....	.....	.....
2.	29·869	29·748	29·60	30·06	30·14	64	47	51·5	48	46	e.	e.	ese.	·06	.....	·02
3.	29·802	29·658	29·50	30·15	30·23	55	47	52·5	55	45	e.	e.	e.	·58	.....	.....
4.	30·073	30·042	29·75	30·33	30·30	55	39	58·5	48	42½	e.	ene.	se.	.....	.....	.....
5.	30·141	30·014	29·86	30·23	30·19	61	31	49·5	49	42	e.	e.	n.	.....	.....	.....
6.	29·994	29·547	29·66	30·15	29·96	50	35	47	48	38	ne.	n.	n.	.....	.....	·02
7.	29·649	29·530	29·30	29·75	29·76	42	28	45	41½	39	n.	n.	n.	·24	·02	·16
8.	29·615	29·560	29·32	29·52	29·59	53	29	44	39	38½	nw.	n.	ne.	·02	·08	·25
9.	29·510	29·407	29·28	29·73	29·80	52	36	42	44	37	s.	sse.	n.	·24	·15	·12
10.	30·020	29·771	29·47	29·84	29·92	56	27	43·5	42	40	nw.	nne.	nnw.	·02	·45	·14
11.	30·078	30·008	29·83	29·92	30·03	56	31	45	42½	40½	ne.	nnw.	se.	.....	·20	.....
12.	29·988	29·923	29·74	30·17	30·28	57	42	50	46	44	e.	ne.	ese.	.....	.....	.....
13.	30·012	30·010	29·74	30·34	30·34	56	37	49	48	46	se.	e.	se.	·13	.....	.....
14.	30·007	29·876	29·75	30·25	30·18	61	40	57	51	47	e.	e.	se.	·01	.....	.....
15.	29·856	29·672	29·58	30·12	30·12	67	49	50	50½	48½	se.	e.	se.	.....	.....	.....
☽ 16.	29·669	29·598	29·40	30·11	30·08	69	47	57	53	46	e.	ne.	ese.	.....	.....	.....
17.	29·712	29·659	29·42	30·03	30·00	71	40	52	53	48	se.	ene.	se.	.....	.....	.....
18.	29·901	29·864	29·55	29·94	29·97	72	39	53	54	48½	se.	ne.	.....	.....	.....	.....
19.	29·964	29·896	29·56	30·00	30·03	72	40	58	54	49	se.	n.	ese.	.....	.....	.....
20.	30·053	30·012	29·70	30·04	30·03	68	30	51	51½	49	e.	ene.	ese.	.....	.....	.....
21.	30·076	29·989	29·72	30·07	30·17	65	40	57·5	56	49	e.	e.	ese.	.....	.....	.....
○ 22.	30·083	30·060	29·76	30·28	30·31	66	39	55·5	58	52	ne.	e.	se.	.....	.....	.....
23.	30·070	29·979	29·76	30·24	30·18	69	45	52	53½	52	e.	nne.	se.	.....	.....	.....
24.	29·968	29·803	29·68	30·16	30·03	71	48	57·5	59	52½	e.	ene.	se.	.....	.....	.....
25.	29·735	29·576	29·43	29·96	29·79	72	40	59·5	61	51	e.	ene.	se.	.....	.....	.....
26.	29·576	29·526	29·20	29·62	29·64	76	48	57	59	51½	n.	n.	wnw.	.....	.....	.....
27.	29·642	29·583	29·24	29·68	29·71	73	46	62	54	51	n.	n.	ese.	·18	.....	.....
28.	29·703	29·669	29·26	29·59	29·64	63	43	58	56	52	sw.	w.	e.	·02	.....	.....
☾ 29.	29·861	29·817	29·40	29·78	29·94	66	41	57	57	54	ne.	nnw.	nw.	·08	.....	.....
30.	29·974	29·940	29·55	30·12	30·20	65	48	61·5	57	49	ne.	n.	e.	.....	·10	.....
31.	30·014	29·909	29·65	30·19	30·14	55	50	53	59	49	n.	nne.	s.	·02	.....	.....
Mean.	29·887	29·788	29·55	30·007	30·021	62·77	40·06	53·0	51·59	46·56				1·60	1·00	0·71

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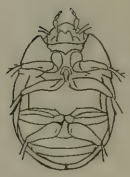
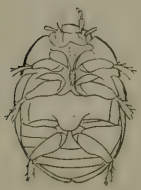


Cyclonotum



Sphaeridium

Cercyon

Pelosoma

Megasternum

Cryptopleurum

Camb. from Mellaart. A.M.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

No. 68. AUGUST 1853.

VIII.—*On the Genus* Cercyon, *with a short Monographical Synopsis of the British* Sphæridiidæ. By ANDREW MURRAY, W.S. Edinburgh*.

[With a Plate.]

THIS is one of those genera of Coleoptera which have always been a stumbling-block to British entomologists.

The large number of species described by Kirby and Stephens, coupled with the shortness of their descriptions given by Stephens, have led to a confusion which is almost inextricable. With the exception of one or two of the most marked species, scarcely any two collections have the same species under the same name, and in attempting to find representatives for so many, one species is necessarily made to play many parts. After a recent fruitless endeavour to collate and reconcile the British and continental names, I was about to give up the attempt in despair, and to abandon the British names altogether, and confine myself to those of Mulsant, Heer, and other continental authors, when my friend the Rev. William Little kindly submitted the whole of his Cercyons to me for examination; and as his species had all been named by Mr. Stephens himself, I had the means (second only to an examination of the original specimens from which the species had been described) of reconciling the synonymy of the British and foreign authors. The distance of my place of residence from London rendered it impossible for me to avail myself with effect of the well-known liberality with which Mr. Stephens gave access to his cabinet; but even although I had had time to examine his specimens minutely, the examination would not have been absolutely satisfactory, because many of the species described by him were first named by Kirby, and the types from which Kirby's species were named are not to be distinguished

* Read at the Royal Physical Society, Edinburgh, 1852.

in his collection, which now forms the ornament of the Entomological Society of London. Mr. Little's collection, so far as it goes therefore, has an authenticity on the whole not very greatly behind Mr. Stephens's own. Unfortunately his collection, although large, does not contain specimens named by Stephens of the whole of the species described in his works. Still it contains a considerable portion, having 32 out of 58 species, and it has occurred to me that information even to this extent will be acceptable to many of our entomologists.

On examining Mr. Little's collection, I have identified the following species of Stephens with those of Mulsant, viz.:—

C. ruficorne,
littorale,
binotatum,
dilatatum,
} *Steph.* = Cercyon littorale, *Muls.*

C. hæmorrhoidale,
piceum,
} *Steph.* = C. hæmorrhoidale, *Muls.*

C. hæmorrhoidale, Steph., is represented by specimens of *C. littorale*, but this must be by mistake, as Stephens's description answers better for *C. hæmorrhoidale* than *littorale*.

C. Boletophagum,
aquaticum,
flavipes,
immune,
stercorarium,
immaculatum,
} *Steph.* = Megasternum Boletophagum, *Muls.*

C. terminatum,
infuscatum,
apicale,
} *Steph.* = Cercyon anale, *Muls.*

C. lævigatum,
convexior,
} *Steph.* = C. minutum, *Muls.*

C. obsoletum, *Steph.* = C. obsoletum, *Muls.*

C. laterale, *Steph.* = C. laterale, *Muls.*

C. picinum,
suturale,
femorale,
} *Steph.* = C. flavipes, *Muls.*

C. pygmæum,
conspurcatum,
stercorator,
} *Steph.* = C. pygmæum, *Muls.*

Although Mr. Little's specimen of Stephens's *C. conspurcatum* is *melanocephalum*, it has been ascertained by Mulsant from other sources to be *pygmæum*.

C. melanocephalum, *Steph.* = C. melanocephalum, *Muls.*

C. atomarium,
sordidum,
merdarium,
} *Steph.* = Cryptopleurum atomarium, *Muls.*

C. ustulatum,
bimaculatum,
} *Steph.* = C. centrimaculatum, *Muls.*

C. quisquilium, *Steph.* = C. unipunctatum, *Linn.* ♀.

The above information clears up the synonymy of the genus to a certain extent, and by examining Stephens's descriptions, aided by the light derived from a comparison of the above species which have been identified, with *their* descriptions, and by an examination of other cabinets in which I have found what have been supposed by others to be the species corresponding to Stephens's names, I shall venture to give a list of our British Sphæridiidæ with a more extended synonymy—the rather, that as I have explained my sources of information, no one can be deceived into attaching more weight to my opinion than it is justly entitled to. I adopt the arrangement and characters of Mulsant, and I dare say it will be acceptable to our younger entomologists, if I digest it into the shape of a short monograph, noticing briefly those distinctive characters which can be readily seized, but referring them to Mulsant and other authors for full and extended descriptions.

Mulsant divides the Palpicornes of France into two groups, the HYDROPHILIDÆ and GEOPHILIDÆ, which are distinguished from each other by the former having the first article of the posterior tarsi always shorter than the second, while the latter has it always longer than the second.

The group HYDROPHILIDÆ is composed of the genera *Spercheus, Helophorus, Hydrochus, Octhebius, Hydræna, Limnebius, Berosus, Hydrophilus, Hydrous, Hydrobius, Laccobius, Helophilus, Philhydrus,* and *Cyllidium.*

The group GEOPHILIDÆ, with which we have to do, is composed of the genera *Cyclonotum, Sphæridium, Cercyon, Pelosoma, Megasternum,* and *Cryptopleurum.*

He separates the four first genera of this second group into one division, "*Sphæridiares,*" distinguished by having the mesosternum much longer than broad, and compressed into a kind of blade. The two last form another division, "*Megasternares,*" which has the mesosternum not longer than broad, and of an irregular pentagonal form.

The mesosternum also furnishes characters sufficient to distinguish the four genera of *Sphæridiares* from each other, viz.:—

Cyclonotum. Has the mesosternum terminated in front by an arrow-head shape; scutellum almost an equilateral triangle.

Sphæridium. Mesosternum compressed into a blade of equal thickness, not terminated in an arrow-head; scutellum twice as long as broad.

Cercyon. Mesosternum sublinear, sharpened both before and behind; scutellum subequilateral, or not more than a half longer than broad.

Pelosoma. Mesosternum linear, but sharpened before and truncate behind.

For the more easy understanding these distinctions I annex a Plate (Pl. IV.), showing the under side of the different genera composing the *Geophilidæ*, copied from Mulsant's figures in the 'Palpicornes de France.'

CYCLONOTUM, Dej., Erich.

Hydrophilus, Fab., Herbst, Marsh., Steph.
Cœlostoma, Brullé, De Casteln.

C. orbiculare, Fab., Erich., Heer, Steph., &c.

Subhemispheric, above brilliant black, closely covered with punctures, which are smaller on the head and thorax than on the elytra. The elytra have a single stria next the suture shortened anteriorly; under side of body, thighs and legs of a brown black, tarsi livid testaceous.

Var. B. *C. Allabroix*, De Casteln. Upper side of body brown-black, and gradually brownish yellow on the margins of the prothorax and elytra.

Length $1\frac{1}{2}$ to $2\frac{1}{2}$ lines; breadth 1 to 2 lines.

In general appearance this species approaches nearest to the *Hydrobii*; like the most of them it is densely punctured all over, and has a single sutural stria, but is at once distinguished from them by the first article of the posterior tarsi being longer than the second, which, as already mentioned, is the character which separates this group from the *Hydrophilidæ*. It has also some resemblance to the Cercyons, more particularly *C. obsoletum*, Muls., which is about the same size, but is easily recognized by its having no striæ on the elytra except the sutural, while all the Cercyons are marked with ten or eleven striæ.

It is a water insect, and is found in stagnant water or under the debris on the margins of lakes and ponds. Found both in England and Scotland, but not very common.

SPHÆRIDIUM, Fab.

Dermestes, Schrank, Fourc., Marsh.

Sph. scarabæoides, Linn., Fab.
4-*maculatus*, Schrank.

Body above of a shining black, densely punctured; prothorax a fifth or a fourth longer in its middle than at the sides; elytra with a red mark behind the shoulder, and a semicircular reddish yellow blotch at the apex; under side of body and of legs nut-brown.

The ♂ is distinguished from the ♀ by having the last article of

the fore tarsi swollen, and one of the nails of the same feet very thick and strongly curved, while in the ♀ these parts are in a normal state.

Var. B. Prothorax with a red or yellowish red margin, sometimes shortened.

Var. C. *Sph. lunatum*, Fab.
bipustulatum, Herbst.
scarabæoides, Illig.

Elytra without a spot behind the shoulder.

Var. D. Legs spotted with yellowish red.

Length $2\frac{1}{2}$ to 3 lines; breadth $1\frac{2}{3}$ to 2 lines.

Common both in Scotland and England in cow-dung, &c.

Sph. bipustulatum, Fab.

Body above shining black, densely punctured; prothorax a third longer in the middle than on the sides, margined on the sides with yellowish red, with the hinder angles curved backwards almost in the form of a tooth; elytra with a lateral border and an apical blotch almost semicircular, both of yellowish red; under side of body brownish black; legs generally of reddish yellow with a black blotch on the middle of the thighs.

♂ and ♀ distinguished by the same characters as the preceding species.

Var. B. *Sph. bipustulatum*, Fab.
hæmorrhous, Schrank.
testudinarius, Fourc.
marginatum, Scriba, Payk., Lat., Gyll., &c.
scarabæoides, Laich., Illig.
semistriatum, De Casteln.

Elytra with a semicircular blotch towards the extremity from the suture almost to the outer edge; *α.* sometimes dilated to the apical margin; *β.* at other times reduced to a punctiform blotch near the suture; *γ.* prothorax and elytra, sometimes the one and sometimes the other, without a red border on the edges; *δ.* elytra generally marked with rows of punctures in striæ more or less distinct.

Var. C. *Sph. 4-maculatum*, Curtis, Marsh.
marginatum, Gyll., var. *c.*; Zetterst. var. *c.*; Heer, var. *d.*
bipustulatum, Steph. syn.

Similar to the preceding type. Elytra marked besides with a subhumeral red blotch, reduced sometimes to a sort of reddish transparence.

Var. D. *Sph. scarabæoides*, Sturm.

Elytra marked with a subhumeral red blotch more or less decided, without any blotch at the extremity; β. as in the type; γ. elytra sometimes marked with striated rows of punctures.

Var. E. *Sph. marginatum*, Fab., Payk., Gyll., Curtis, Steph. syn. &c.
scarabæoides, Illig. var. β.; Sturm, var. *e.* & *g.*; Schön. var. γ.; Lat. var. D.
4-maculatum, Steph.
Daltoni, Steph.

Upper side of body entirely black, with the outer edge of the prothorax and elytra red or yellowish red; β. prothorax or elytra, sometimes one and sometimes the other, without a red border on the sides; δ. elytra offering rarely slight traces of striated rows of punctures.

Length $1\frac{3}{4}$ to $2\frac{1}{2}$ lines; breadth $1\frac{1}{4}$ to $1\frac{3}{4}$ line.

This species varies much in colour. Commonly it is entirely black above, with the exception of the yellowish border. The variations offer all the gradations between the varieties cited above.

It differs from the preceding species in its smaller size, in its prothorax being more sinuous at its base, and more sensibly curved behind at its posterior angles. The black blotch on the middle of the thigh, though not always to be trusted to, generally gives a ready indication of the species.

Heer describes two species of *Sphæridium* as being found very rarely in Switzerland; one, *S. striolatum*, Heer, distinguished from *scarabæoides* by its more convex form and the punctuation of the elytra being a little deeper, and the elytra striolated along the suture at the scutellum; and the other, *S. testaceum*, Heer, distinguished from *marginatum* by being wholly testaceous and smaller and more finely punctate. I am inclined to doubt if either of these is a good species.

Cercyon, Leach.

Sphæridium, Gyll., Oliv., Payk.
Dermestes, Marsh.
Hydrophilus, Fab.

Div. 1. Mesosternal plate visibly detached at its posterior extremity from the metasternum.

A. Intervals between the striæ on the elytra visibly punctate.

C. obsoletum, Gyll., Steph., Muls.
lugubre, Oliv., Lat., Marsh. (not Erich., Heer, Muls.).
atomarium, Payk. (not Steph.).

Oval, narrower behind. Upper side of body finely punctate. Head and prothorax shining black; the latter scarcely shorter in the middle than at the sides. Elytræ black with the extremity gradually reddish, with light striæ marked with cycloid punctures; the fourth stria almost angular at the fourth part of its length, and rendering the fifth interval gradually broader from this point to the base.

Length $1\frac{1}{2}$ to $1\frac{3}{4}$ line; breadth 1 to $1\frac{1}{2}$ line.

This species is readily distinguished from all the others by its greater size, being the largest of the genus, and by the fourth stria on the elytra making an almost angular bend towards the suture at a short distance from the base, thus gradually increasing the breadth of the fifth interval at the base. The extent of the paler reddish tint at the apex varies, and it may be as well to mention here, that in this genus (indeed in the whole group) colour is very little to be depended on. The whole genus has a disposition to be paler at the apex than on the rest of the body, but several of the species vary from dark black to pale testaceous. The colouring matter appears to have circulated from the head or middle of the prothorax to the extremity, and to have reached different lengths in different individuals, one having the paleness of the apex almost extinguished, while another has a pale blotch extending halfway up the elytra, or even over the whole body.

This, as well as all the other species of the genus, feeds on the dung of herbivorous animals, or, as Mulsant more elegantly expresses it, "on vegetable matter which has been animalized by passing through the digestive tube of certain mammiferæ." The species is not rare in Britain, but is by no means so plentiful as some of the following.

C. hæmorrhoidale, Fab., Steph., Muls.
melanocephalum, var. β. Illig.
obsoletum, De Castel.

Body short, oval, narrower behind, finely punctate above. Head and prothorax shining black, the latter a fourth shorter on the sides than in the middle, marked with a depression before the scutellum. Elytra moderately convex on the back, convexly subperpendicular on the sides; black at the base, gradually becoming reddish brown or brown at the extremity, with striæ edged each by a row of cycloid punctures; the fourth not angular.

Var. B. *C. piceum*, Marsh., Steph.

Elytra entirely of a reddish brown, gradually paler towards the extremity.

Var. C. *C. impressum*, Sturm, Steph.

Black, with the elytra red except a triangular black patch at the middle of the base of the elytra surrounding the scutellum, and the margins of the base of the elytra also black extending to the triangular patch.

Length $1\frac{1}{4}$ to $1\frac{1}{2}$ line; breadth $\frac{7}{8}$ to 1 line.

This species is easily recognized by the dimple on the thorax immediately in front of the scutellum, and by its hump-shouldered appearance. The variety *impressum* is coloured like *melanocephalum*, but is known by the above characters. Not rare.

C. hæmorrhoum, Gyll., Steph., Muls.
hæmorrhoidale, Fab.
melanocephalum, var. β. Illig.
xanthorrheum, Leach, Steph.

Oval, less rounded posteriorly, densely marked with small punctures above. Head and prothorax brilliant black; prothorax sensibly longer in the middle than on the sides, and more elevated a little in front than at the base. Elytra subconvex on the back, convexly subperpendicular on the sides; black, passing rather abruptly to red in the posterior third part, with the suture black; with very marked striæ, the dorsal ones less distinctly punctate.

Length 1 to $1\frac{2}{3}$ line; breadth $\frac{7}{8}$ to 1 line.

This species is not so easily recognized at first sight as the last, but it also has a distinctive mark which fixes it. On looking at the insect sideways, its thorax is seen to differ in shape from all the others. In them the thorax gradually rises from the head until it meets the elytra, which join it without disturbing the general curve of the body. Seen sideways the whole body looks like the segment of a circle. In *hæmorrhoum* this is not the case; the thorax rises from the head in a curve, but before reaching the elytra it falls again, and the elytra commence their rise from the thorax, so that the profile is that of two segments of a circle meeting at the base of the thorax. The suture also is dark at the apex, while in most other pale-tailed species it is concolorous.

Rare. I have taken one specimen in Scotland.

C. laterale, Steph., Muls.

Shortly oval or suboviform; moderately convex and thickly marked with small punctures above. Head and prothorax black; prothorax reddish brown on the sides. Elytra becoming narrower from a third of their length; of a red-brown paler towards the extremity; with eleven narrow striæ, marked with round

punctures scarcely larger than them; dorsal intervals less deepened towards their posterior two-thirds.

Length 1 to 1½ line; breadth ⅔ to 1 line.

This is a large species, next in size to *C. obsoletum*, Muls., and of a somewhat globular shape. The elytra are of a chestnut-brown colour, with a dark or black transverse line along the base. It is to be distinguished at this point from *flavipes*, Muls., which has also a dark impression running along the base, but *flavipes* has another dark impression running down the suture, only reaching about halfway down, and leaving the suture pale at the patch at the apex, while *laterale* has no black on the suture at the base, but has it darker than the surrounding parts at the apex. It is to be distinguished from *C. obsoletum* by its fourth stria less angular, from *hæmorrhoidale* by its thorax without a depression in front of the scutellum, and from *hæmorrhoum* by the form of the thorax.

Occasional both in Scotland and England.

C. unipunctatum, Linn., Fab., Muls., &c. Erich. ♀, Heer ♀.
* *cordiger*, Fuessly, Herbst.
dispar, Payk. ♀.
quisquilium, Steph. ♀.

Oval, rounded in front. Head and prothorax densely punctate, shining black; prothorax edged on the sides with yellow. Elytra yellow or reddish yellow, with the suture black, and upon it a black blotch common to each elytron, with ten striæ; the dorsal striæ less distinctly punctured in the middle; the lateral striæ reduced to striated rows of punctures. The legs and sometimes a part of the belly of reddish yellow.

Var. B. Black mark on the elytra very much reduced, or very pale, sometimes almost wanting.

Length 1 to 1⅔ line.

This species cannot be mistaken for any other. Its head and thorax black, and its elytra yellow, with a large heart-shaped black patch on the middle of the suture extending over both elytra, sufficiently distinguish it.

Common.

C. quisquilium, Linn., Steph. ♂, Erich. ♂, Heer ♂, Muls.
minimus, Scop.?
xanthopterum, Laich., Schrank.
unipunctatum, Fab., Illig. ♂, Sturm ♂.
melanocephalum, var. Herbst.
dispar, Payk. ♂.

Oval oblong, more rounded in front. Head and prothorax brilliant black, densely marked with small punctures. Elytra

straw-yellow, reddish at the suture, obscure or blackish towards the sutural angle, with ten punctured striæ; the lateral striæ reduced to striated rows of punctures. Legs testaceous yellow.

Var. B. *C. flavum*, Steph. syn.

Prothorax with a narrow yellow border on the sides.

Var. C. *C. scutellare*, Steph. syn.

Elytra appearing marked with a black triangular blotch surrounding the scutellum.

Length $\frac{5}{4}$ to 1 line.

This species in outline and general appearance greatly resembles the preceding, but wants the heart-shaped black patch on the back: it has been generally supposed to be its male. Mulsant, however, states that individuals of both sexes are found with the characteristic mark of each, and that therefore the one cannot be the male of the other. A positive statement of this kind coming from one who has studied the genus so much as Mulsant, drives us either to admit them to be different species or varieties of the same species. I confess that, although in deference to Mulsant's authority I have here kept them apart as different species, my own opinion is that they are connected together in some way or other, if not as sexes at least as varieties. Whenever a few specimens of one are taken, some of the other are sure to be taken along with them.

Common.

C. centrimaculatum, Sturm, Erich., Muls.
pygmæum, Gyll. (not Illig., Steph., Muls.).
bimaculatum, Steph.
ustulatum, Kirby, Steph.
inustum, Marsh., Steph.
nubilipenne, Steph.

Oval, moderately convex and somewhat depressed, shining and finely punctured above. Head and prothorax black; the latter reddish on the sides, rounded at the posterior angles, with the edges turned up on one part of the base. Elytra testaceous red, with a blackish mark or cloud on the disk of each, with the striæ punctate; second, third and fourth intervals subconvex, and as narrow at their extremity as the sutural one.

Var. B. Elytra entirely testaceous red, or testaceous yellow.

Length $\frac{1}{2}$ to $\frac{2}{3}$ line.

Its small size and yellow elytra, with a dark cloud on the disk of each, generally enable us to distinguish this species at first sight. It has sometimes the elytra coloured like *quisquilium*, but its small size, more depressed form and the other characters above mentioned distinguish it.

Common.

C. pygmæum, Illig., Steph., Muls.
stercorator, Steph.
ferrugineum, Herbst (not Steph.).
Var. *conspurcatum*, Sturm, Steph.
Var. *merdarium*, Sturm (not Steph.).
scutellare, Steph. ?
plagiatum, Erich. ?

Oblong, oval, rather convex, shining and finely punctate above. Head and prothorax black, the latter arched laterally with posterior angles prominent; the edges not turned up at the base. Elytra somewhat rugulose anteriorly, black, with more or less of the sides and apex of a livid red colour, with punctate striæ second, third and fourth intervals depressed, and sensibly broader at their posterior part than the sutural one.

Var. A. Elytra entirely black except the extremity, which is reddish.

Length $\frac{1}{2}$ to $\frac{5}{4}$ of a line.

This species is about the same size as the last, and when they are both in their normal state of colour is easily distinguished from it by the colour, the elytra of this never being yellow with a black patch on the disk. Its general form also distinguishes it; it is a deeper and narrower insect, wants the turned-up edge at the base of the prothorax, and the second, third and fourth intervals between the striæ are wide posteriorly. The variety *conspurcatum*, Steph., has the elytra testaceous with a triangular black patch at the base like *melanocephalum*.

Common.

C. littorale, Gyll., Steph., Muls.
ruficorne, Kirby, Steph.
binotatum, Steph.
dilatatum, Steph.

Oval, feebly convex, black or brownish black above, and densely marked with small punctures. Epistome of the form of a parallelogram, somewhat cut out in front. Prothorax as short in the middle as on the sides. Elytra broadest in the middle, with eleven punctate striæ gradually deepening posteriorly. Intervals subconvex at the extremity.

Var. B. Elytra bordered on the sides with yellowish red for half their length, and with a patch of the same colour at the apex; *α*. prothorax entirely black; *β*. prothorax bordered with red on the edge.

Var. C. Like the preceding; but elytra also with a reddish yellow patch at the base, sometimes extended so much as to

leave only a black spot on the disk, at other times reduced to a sort of reddish point. Prothorax, α. entirely black; β. bordered with red; γ. entirely of a reddish brown or testaceous red.

Var. D. Head brown. Prothorax black or reddish brown. Elytra entirely testaceous red.

Var. E. Elytra very much dilated.

Length 1 to 1½ line; breadth ⅔ to 1 line.

This species, although variable, is in general easily distinguished. Its oblong depressed form of body, with striæ very slight at the base of the elytra deepening gradually into deep sulci towards the apex, are peculiar to itself.

Common on the sea-shores under marine rejectamenta.

C. aquaticum, Steph., Muls.

Oval, at least as broadly rounded in the last fourth as in the first, moderately convex and densely marked with small punctures above. Head and prothorax black, the latter bordered with red on the sides; sutural angle of elytra at the apex straight, with eleven narrow striæ marked with round punctures scarcely broader than the striæ; black, with the extremity and a lateral border yellowish red. Mesosternal plate somewhat ovular.

Var. B. The reddish brown or testaceous red margin of the sides of the prothorax reduced to a punctiform patch, more or less apparent near the anterior angles.

Length 1 to 1½ line; breadth ⅔ to 1 line.

This has much analogy with the following species. The characters which distinguish it are these:—It wants the prolongation at the apex of the elytra, of which I shall presently speak, has the margin of the thorax pale instead of black, wants the black base and suture of the elytra, has the mesosternal plate of an ovular form instead of a linear form, and is altogether of a more oval shape.

C. flavipes, Fab., Steph., Muls.
hæmorrhoidale, Sturm.
melanocephalum, Gyll.
suturale, Steph.
femorale, Steph.
picinum, Steph.

Oblong oval, less broadly rounded in the last half than in the first, moderately convex and densely marked with small punctures above. Head and prothorax black. Elytra below prolonged

in the form of a beak at the sutural angle at the apex, anteriorly of a reddish brown, marked with a black line along and a black line down the suture for a third of its length, assuming the appearance of a black T; brown in their middle, with the posterior part and external margin of a livid testaceous red. Mesosternal plate linear.

Var. B. Elytra nut-brown or black-brown, with the black line on the base and suture not distinguishable.

Length $1\frac{1}{8}$ to $1\frac{1}{2}$ line; breadth $\frac{7}{8}$ to 1 line.

This species generally figures in British collections as *C. sutu-rale*. I do not think Stephens knew what the true *flavipes* was. His species under that name, as I have already shown, was *Megasternum Boletophagum*. The black marks at the base of the elytra and down the suture forming a black T readily distinguish it when these marks are decidedly present; they are, however, sometimes not observable, when the form of the elytra and of the mesosternal plate, coupled with the prolongation at the apex of the elytra, will distinguish it. The elytra are less rounded behind than the preceding species, and the mesosternal plate linear. The prolongation at the apex of the elytra is sometimes very distinct, so much so as almost to take the form of a beak, as if some one had taken the apex of the elytra when soft close to the suture and given it a pinch with their nails, but generally it has more the appearance of a small indentation.

Common.

C. melanocephalum, Linn., Steph., Muls.

Oval oblong, less rounded posteriorly, convex, shining, and finely punctate above. Head and prothorax black. Elytra often slightly prolonged like an obtuse beak at the sutural angle at the apex, testaceous red, paler towards the apex, with a triangular patch upon and around the scutellum, and the base of the external margin black with slight striæ, often little visibly punctate on the back.

Length 1 to $1\frac{1}{5}$ line; breadth $\frac{2}{3}$ to $\frac{7}{8}$ line.

This is a common species, whose colour is pretty constant, and is easily known by its red elytra with a black triangular scutellar patch. The var. *impressum* of *hæmorrhoidale* and the var. *conspurcatum* of *pygmæum* both have a similar triangular patch, but the former is so much larger and the latter so much smaller than this, as at once to suggest a query as to their species, when their other characters will prevent their being confounded.

Very common.

Mulsant notices another species, *C. erythropterum*, which

should come between *C. flavipes* and *C. melanocephalum*. It has the head and prothorax black, the elytra red, paler at the extremity, furnished with a kind of black T covering the internal half of the base and a third of the suture. It is more oviform and more regularly convex than *C. flavipes*, and its elytra are not obscure in the middle. It is a Sicilian species and not likely to be found in this country.

B. Intervals of the elytra appearing smooth.

Obs. These intervals when examined by a strong lens are found to be obsoletely covered with confluent punctures, and have a silky appearance.

C. minutum, Fab., Steph., Muls.
triste, Illig. (not Gyll.).
lævigatum, Kirby, Steph.
convexior, Marsh., Steph.
convexius, Kirby, Steph.
convexiusculum, Marsh., Steph.

Oviform, convex, chestnut-black or black above. Head and prothorax finely punctate. Elytra passing to brownish red at the extremity; striæ punctate, slight and less distinct posteriorly; intervals appearing smooth and silky. Mesosternal blade ovular. Length $\frac{5}{4}$ to 1 line.

This is easily distinguished from the rest by the elytra, which have a dull, opake, silky or greasy appearance, and have the intervals apparently impunctate. *C. lugubre* is the only other which has elytra with the intervals impunctate; but *C. minutum* is less convex than it, and has a less decided patch of red at the apex; besides, the striæ disappear before the apex, which in *lugubre* they do not.

Occasional.

C. lugubre, Payk., Erich., Heer.

Oviform, very convex and shining black above. Head and prothorax finely punctate. Elytra testaceous red towards the extremity, with eleven narrow striæ slightly punctate and a little deeper behind. Mesosternal blade oval, twice as long as broad. Length $\frac{3}{4}$ to $\frac{7}{8}$ of a line.

I cannot say whether this species is found in Britain or not. I have seen no specimen of it, but Stephens records the species as found in the London district and in Norfolk and Suffolk. It can only be confounded with *C. minutum*, from which the distinctions I have specified under it will distinguish it.

Erichson describes a Swiss species, *C. granarium*, Erich., as closely allied to this, principally distinguished by the second article of the palpi being much thicker.

Div. 2. Mesosternal blade appearing united to the metasternum, which appears excised at its anterior end.

C. anale, Payk., Erich.
terminatum, Marsh., Steph.
flavipes, Thunb.
apicale, Steph.
infuscatum, Steph.

Oval oblong, diminishing almost uniformly for the last three-fourths of the elytra, and terminated in a point. Head and prothorax finely punctate, brilliant black. Elytra of the same colour with a patch of testaceous red at the apex, stopping somewhat abruptly, and not covering the suture; striæ punctate; the intervals with a nearly double row of punctures on the anterior half, and a single row on the posterior.

Var. B. *C. marginellum*, Payk. Sides of prothorax, and sometimes also those of the elytra, reddish brown.

Var. C. Body above reddish brown, or testaceous red, more or less livid on the prothorax and elytra, with the apex of the latter paler. Head blackish.

Length 1 line; breadth $\frac{2}{3}$ of a line.

This species is recognized by the acute form of the hinder part of the body, and by the shape of the mesosternal plate, which is almost linear.

Occasional.

PELOSOMA, Muls.

Cercyon, Dej.

P. Lafertei, Muls.
bicolor, Dej.

Oviform, convex, and covered with small punctures above; black or nut-brown, with the anterior part of the epistome and the sides of the prothorax gradually reddish. Form of scutellum a rectilinear triangle. Elytra broadest towards the third of their length, with eleven striæ slightly punctate and deepest behind.

Length 1 line.

There is only one species of the genus, and the mesosternal blade truncate behind is a sufficient distinction. I am not aware that it has been found in Britain, but have added the description to make this sketch more complete.

The division of the *Sphæridiidæ*, called by Mulsant *Megasternares*, which comes next, has entirely the aspect of the Cercyons, and, as already mentioned, is distinguished by having its meso-

sternum broader than long and irregularly pentagonal. It contains only two species so far as yet known, each of which has been constituted by Mulsant into a separate genus.

The characters are as follows:—

Megasternum. Sides of thorax not turned in below; prosternum lozenge-shaped, longitudinally keeled.

Cryptopleurum. Sides of thorax folded in below in the form of a triangle; prosternum pentagonal, with its broadest side in front.

Megasternum, Muls.

Cercyon, Steph.

M. Boletophagum, Erich., Muls., Steph.
acutum, Steph.
immune, Kirby, Steph.
stercorarium, Marsh., Steph.
immaculatum, Kirby, Steph.
læve, Marsh., Steph.
contaminatum, Kirby, Steph.
ferrugineum, Marsh., Steph.
concinnum, Marsh., Steph.?
fuscescens, Steph.?
testaceum, Steph.?
immundum, Steph.?
castaneum, Heer?

Short, oviform, decidedly convex, shining brownish black above. Head and prothorax punctate. Elytra diminishing to the apex, with ten slight rows of punctures; intervals more finely punctate than the thorax.

Length $\frac{1}{2}$ to 1 line; breadth $\frac{1}{3}$ to $\frac{2}{3}$ of a line.

The shape of the mesosternal plate and prosternum at once easily distinguish this from all the other species of *Cercyon*; but its body above is also recognizable by a glassy semitransparent lustre which no other species has. It is exceedingly variable in size and colour, and in depth of striæ and punctuation. Sometimes it is a full line in length, occasionally not much more than half a line. It is generally dark chestnut-coloured, but sometimes quite black; sometimes the striæ are well-defined, at others scarcely perceptible, but the form of its mesosternal plate, its glassy lustre, and a peculiarity in the puncturing of the striæ will always distinguish it. The punctures in the striæ are not as if they had been impressed vertically, as is usually the case, but as if a needle had been held slanting forwards and a succession of nearly horizontal pokes had made the punctures.

Notwithstanding the great variety in the points to which I have alluded, there is no insect in the group more readily recog-

nized by an eye once familiar with it. Kirby and Stephens, however, never seem to have been so, as will be seen from the synonymy I have given. They seem to have been misled by every trifling variety; for instance, *C. stercorarium*, Steph., and *immaculatum*, Steph., are small black specimens, the one somewhat crumpled and the other very little marked. *Boletophagum* is a large specimen, *immune* a small one, and so on. The above synonymy I have confined to the genus *Cercyon*, but I found from Mr. Little's collection that Mr. Stephens had carried this species also into other genera, as it formed his representative for *Phalacrus pulchellus*, Steph., and *Phalacrus geminus*, Steph. This, however, was no doubt merely by mistake, at least as far as regards the latter, which is a good species, bearing a certain resemblance to *Megasternum Boletophagum*.

The species is very common.

Cryptopleurum, Muls.

Cercyon, Steph.

C. atomarium, Fab., Steph.
crenatum, Panz., Steph.
minutum, Payk. (not Steph.).
merdarium, Steph.
var. *sordidum*, Marsh., Steph.

Shortly oval, broadest in the anterior part. Head and prothorax obscure black, densely covered with small punctures; the prothorax angularly folded in below. Elytra black, gradually livid red towards the extremity, with eleven deep crenulated striæ, the seventh almost confounded with the eighth, which is broader. Intervals subconvex punctate, and furnished with hairs.

Var. B. Elytra almost entirely testaceous red, paler towards the extremity; prothorax sometimes testaceous red on the sides.

Length $\frac{2}{3}$ to 1 line.

The shape of the mesosternum and prosternum at once distinguishes this species when seen from below; when seen from above it will be known by the coarse appearance of the upper sides and its deeply crenate striæ.

Common.

The above species of *Cercyon*, *Pelosoma*, *Megasternum*, and *Cryptopleurum*, include the whole of the British species of the old genus *Cercyon* which can be recognized from their descriptions. They amount to 18 in number, and I have little doubt that the whole of Stephens's 58 species will ultimately be found to come under one or other of them; indeed, I think I have above

determined the whole of them, with the exception of *C. Calthæ, xanthocephalum, erythropus, obscurum* and *nigriceps*. Heer has a species, *C. pulchellum*, found in Switzerland, which, from his insufficient description, I have been unable to identify. With the above exceptions I think I have noticed the whole of the European species hitherto known.

IX.—*Characters of new Land Shells, collected by* Edgar L. Layard, Esq., *in Ceylon*. By W. H. Benson, Esq.

1. *Streptaxis Layardiana*, nobis.

Testa arcuato-rimata, depresso-ovata, abbreviata, lata, leviter striata, albido-cornea; spira subelevata, apice planulato, excentrico; sutura crenulata: anfractibus 5, convexiusculis, ultimo ad latus deviante, basi convexiuscula, lævi; apertura straminea, subtriangulari uniplicata, marginibus callo lamellam intrantem validam emittente junctis, dextro expanso reflexiusculo, antrorsum arcuato, superne profunde sinuato, columellari et basali reflexis, umbilico intus rugoso-striato.

Diam. major $10\frac{1}{2}$, minor 8, alt. 4 mill.

Hab. inter lapides ad verticem rupis Mehintali Insulæ Ceylon.

In one or two specimens the callus near the upper margin is inclined to form an obtuse tooth at the side of the sinus, which is much deeper than in *H. Perrotetiana*, Petit, from the Nilgherries.

A graphic account of the discovery is contained in Mr. Layard's Journal in page 235, vol. xi. of the 'Annals.' This and the following curious species, of a singular genus, capriciously distributed through the tropical regions of the globe, are the first which have been found in Ceylon. The head-quarters of the genus are in South America and Western Africa. The remaining species, of which the locality is known, are solitary in the Nilgherry Hills of South India, at Tavoy on the Tenasserim coast of the Bay of Bengal, in Cochin China, and in the Seychelles and Rodriguez, islands of the Southern Indian Ocean.

M. Petit de la Saussaye objects (Journ. de Conchyl. 1851, p. 369) to the reception of *Streptaxis* as a genus, considering it to be inadmissible in a zoological point of view; and he adduces as an argument for rejection the circumstance of its gradual change into *Helix*, through species which belong to the group, although deficient in the principal character of distortion. The same argument might be used against the reception of most other genera. *Bulimus* and *Achatina* have as little title to separation as this genus and *Helix*; and *Streptaxis* has equal claims

to acceptance with Lamarck's genus *Anostoma*, like which the mollusk, to use M. Petit's words, "arriving at a certain stage of growth, abandons in the formation of the shell the regular course followed by the animals of the genus *Helix*."

The separation of such a singular group is, at all events, a great convenience in conchological research.

2. *Streptaxis Cingalensis*, nobis.

Testa arcuatim rimato-perforata, depresso-ovata, solida, abbreviata, lata, obsolete costulato-striata, albido-cornea, subtus polita; spira elevatiuscula, sutura crenulata, apice convexiusculo; anfractibus 6 convexis, ultimo ad latus deviante, basi convexa; apertura subtriangulari, 3-dentata, marginibus callo lamellam intrantem validam emittente junctis, dextro reflexo, antrorsum arcuato, unidentato, superne profunde sinuato, columellari reflexo, ad basin unidentato; umbilico intus striato, linea impressa circumscripto.

Diam. major 11, minor 8, alt. 5 mill.

Hab. in pago Hewagam Corle Insulæ Ceylon, inter rimas saxorum.

Nearly allied to the last, but differing in the dentition of the aperture, in the umbilicus, and in the less flattened form. The replication of the sinus at the top of the aperture simulates another tooth at right angles with the laminar plait on the parietes, a character observable also in *S. Perroteti*, and to which *S. Layardiana* also shows a tendency. It is intermediate between those two species in the dentition of the aperture, but wants the additional tooth which occurs at the base, within the aperture, in the first-named species, from which it is moreover much further removed in form than from *S. Layardiana*.

Mr. Layard has communicated the following note on the animal:—"Epiphragm glassy, animal yellow, with a red line on the back, extending up the two superior tentacles, at the tip of which the eyes are situated: all four tentacles clubbed; when crawling the shell is carried nearly level with the back."

The colouring of the animal reminds me of the hues observable in the *Pupæ* of the Isle of France, as well as in the Indian and Galle species, *P. bicolor* of Hutton. It has already been remarked by others that *Streptaxis* has an obvious affinity with the Mauritian *Pupa Pagoda* in the formation of the shell.

3. *Helix ceraria*, nobis.

Testa obtecte perforata, depressa, nitidula, cerea, radiatim rugoso-striata, striis spiralibus remotiusculis decussata, luteo-fulvida, versus apicem rubescente, spira convexiuscula, apice obtusato; anfractibus 4, superne planulatis, ultimo lato, carinato, subtus convexo; apertura magna, late lunata, peristomate simplici, acuto,

marginibus callo tenuissimo junctis, columellari arcuato, superne breviter reflexo, perforationem inconspicuam fere tegente.
Diam. major 20, minor 16, alt. 10 mill.
Hab. in agris altis Insulæ Ceylon "Horton Plains" dictis.

4. *Helix Puteolus*, nobis.

Testa perspective umbilicata, orbiculato-depressa, lenticulari, supra spurca, albida, subremote radiato-lirata, subtus cornea, radiatim striata; spira planiuscula apice vix prominulo, sutura impressa; anfractibus $5\frac{1}{2}$, angustissimis, convexiusculis, arcte convolutis, omnibus filoso-carinatis, superne sulco carinaque secunda parallelibus munitis, ultimo subtus planiusculo, ad marginem umbilici mediocris profunde excavati, cyathiformis, valde compresso; apertura angusta, securiformi, peristomate recto, acuto.
Diam. major $5\frac{1}{2}$, minor 5, axis $2\frac{1}{2}$ mill.
Hab. in saxis ad portas "Balcadua" dictas, Insulæ Ceylon.

This little shell is singular on account of its sculpture, the narrowness of the whorls, and the sudden and deep excavation of the well-like umbilicus. Vide 'Annals,' vol. vii. p. 305.

5. *Helix Mononema*, nobis.

Testa angustissime perforata, trochiformi, radiato-striata, corneo-albida, glabra, non nitida, translucente, spira conoidea, apice obtuso, sutura distincta; anfractibus $6\frac{1}{2}$–7, superne convexiusculis, filo unico, elevato, tenui, mediano cinctis, ultimo acute filoso-carinato, subtus subplanulato; apertura verticali, securiformi, peristomate recto, acuto, margine columellari brevi, verticali, reflexo, perforationem subtegente.
Diam. major 5, minor $4\frac{1}{2}$, axis 4 mill.
Hab. ad Heneratgodde.

Allied to the Himalayan *H. fastigiata*, Hutton, and to the Bengal *H. Barrackporensis*, Pfr., but well-distinguished by its more depressed form and by the filiform line, which, in addition to the keel on the last whorl, runs along the central part of each of the upper whorls. Mr. Layard had not been able to procure a second specimen.

6. *Helix marcida*, nobis.

Testa subobtecte perforata, depressa, solida, superne oblique regulariter costulata, subtus læviori, sub epidermide fulvido-cornea albida; spira vix elevata, sutura impressa, apice obtusiusculo; anfractibus 6, lente accrescentibus, ultimo rotundato, subtus planulato, apertura sublate lunata, obliqua, peristomate recto, tenui, margine columellari oblique descendente, crassiusculo, superne breviter reflexo, perforationem subtegente.
Diam. major 14, minor 12, axis 8 mill.
Hab. in Insula Ceylon.

7. *Helix vilipensa,* nobis.

Testa aperte perforata, pervia, depressa, solidiuscula, pellucida, cornea, polita; spira convexiuscula, sutura vix marginata, apice obtuso; anfractibus 5, subplanatis, lente accrescentibus, ultimo rotundato, subtus convexiusculo; apertura late lunata, subobliqua, peristomate recto, acuto, margine columellari oblique descendente, expansiusculo, superne breviter reflexo; umbilico pervio.
Diam. major 8, minor 7, axis 4 mill.
Hab. ad rupem Mehintali.

A little Naninæform *Helix* with no very prominent character, differing from Pfeiffer's *H. Perroteti* and other small Helices of the same group, with the exception of a small unnamed Nilgherry shell which is slightly larger, but otherwise not easily to be distinguished from it. From *H. Perroteti* it differs by its more convex spire, rounder periphery, and more open perforation.

8. *Helix perfucata,* nobis.

Testa vix perforata, depressa, translucente, purpureo-fusca, politissima, spira elevatiuscula, sutura submarginata, apice obtuso; anfractibus 4, convexiusculis, arcte convolutis, ultimo rotundato, subtus convexo; apertura lunata, vix obliqua; peristomate recto, acuto, margine columellari verticali, leviter reflexo, umbilico non pervio.
Diam. major 5, minor 4, axis 3 mill.
Hab. in pago Gallensi, inter saxa.

Remarkable for its deep clear purple-brown colour.

9. *Vitrina Edgariana,* nobis.

Testa valde depressa, tenuissima, subtus membranacea, politissima, pellucida, superne obsolete oblique striatula, lineis nonnullis spiralibus impressis ornata, lutescente-cornea; spira planiuscula, apice prominulo, sutura impressa; anfractibus 3 celeriter accrescentibus, planiusculis, ultimo ad periphæriam valde convexo; apertura obliqua, ovato-lunata.
Diam. major 10, minor 8, alt. 4 mill.
Hab. ad Columbo, Hangwelle, et Ratnapoora, insuper folia arbustorum.

Mr. E. Layard remarks, that "the mollusk is very long and attenuated, yellow and white. On touching it, it throws itself off the spot where it crawls, and twists and springs about in a most singular manner, often propelling itself several inches from its starting-point." I have recorded elsewhere a similar habit in a little fresh water shell, *Planorbis rotula,* nobis.

10. *Vitrina membranacea,* nobis.

Testa valde depressa, submembranacea, obsolete oblique striatula,

striis versus apicem confertissimis, pellucida, virente-cornea, polita, superne convexiuscula, apice planato, sutura vix marginata; anfractibus $3\frac{1}{2}$, rapide accrescentibus, ultimo antice lato, subtus planulato, ad periphæriam angustam rotundato; apertura obliqua, ovata, margine superiori prorsus arcuato.
Diam. major 11, minor 8, alt. 4 mill.
Hab. ad portas montanas Balcadua dictas, lapidibus adhærens.

11. *Achatina Veruina*, nobis.

Testa cylindraceo-turrita, valde elongata, sordide albida, inæqualiter striata, spira superne sensim attenuata, sutura impressa, crenulata, apice obtuso; anfractibus $12\frac{1}{2}$–13 angustis cylindricis, ultimo $\frac{2}{11}$ longitudinis vix æquante; apertura verticali, truncato-ovali, peristomate recto, acuto, margine columellari leviter arcuato.
Long. 25, diam. 5 mill.
Hab. ad Nalande.

12. *Achatina pachycheila*, nobis.

Testa ovato-oblonga, striatula, striis exilissimis confertis, obsoletis, spiraliter sub lente decussata, nitida fuscescente-cornea, translucente, spira elongata, subconica, apice obtuso, sutura leviter impressa; anfractibus 6, vix convexiusculis, ultimo $\frac{2}{5}$ longitudinis vix æquante; apertura verticali, oblongo-ovata, peristomate intus albido-marginata, columella præarcuata, margine basali incrassato.
Axis 11, diam. 5 mill.
Hab. ad Heneratgodde.

This little species of a group, which has so many representatives in Ceylon, the Nilgherries, and the damp woody mountains of North-eastern India, with a more slender form than *A. Oreas*, nobis, is well distinguished from the allied forms by its peculiar sculpture under the lens, and by the internal incrassation of the peristome, a feature which is also observable in the species *A. crassilabris*, nobis, from North-eastern India.

13. *Bulimus Panos*, nobis.

Testa rimata, ovato-oblonga, subrugose striata, cornea, spira elongato-conica, sutura mediocri, apice obtuso; anfractibus $6\frac{1}{2}$ convexiusculis, ultimo $\frac{2}{5}$ longitudinis vix æquante, antice subascendente, apertura ovata, edentula; peristomate expansiusculo, acuto, marginibus conniventibus, columellari breviter dilatato, albido.
Long. 11, diam. 5 mill.
Hab. ad Nalande.

This shell has a Pupiform aspect.

14. *Pupa Muscerda*, nobis.

Testa rimata, ovato-oblonga, striatula, cornea, spira elongata, apice obtuso; anfractibus $5\frac{1}{2}$–6, convexiusculis, ultimo tertiam partem

testæ æquante, vix ascendente; apertura ovata, tridentata, peristomate expanso, acuto, marginibus conniventibus, columellari dilatato, albido, plica parietali 1, columellari 1, profundiusculis, dente palatali 1, depresso, obtuso.
Long. 4, diam. $1\frac{1}{2}$ mill.
Hab. ad promontorium "Pedro" dictum.

Found by Mr. E. Layard in old posts, and on Palmyra trees (*Borassus flabelliformis*).

15. *Pupa Mimula,* nobis.

Testa rimata, ovato-oblonga, subcylindracea, oblique tenuiter plicatula, pallide cornea, apice obtuso, sutura profundiuscula; anfractibus 5, convexis, ultimo vix ascendente; apertura ovata, verticali, 5-plicata, peristomate tenui, expanso, marginibus callo tenui expanso junctis, plica 1 intrante, majuscula, parietali, 1 columellari, 1 basali profunda, 2 palatalibus profundis.
Long. 2, diam. 1 mill.
Hab. in vitibus ad Promontorium Pedronis.

A minute species nearly allied to, and somewhat larger than the Himalayan *P. Huttoniana,* nobis. It was taken in abundance by Mr. Layard.

16. *Cataulus Austenianus,* nobis.

Testa subperforata, ovato-pyramidata, solidiuscula, eleganter oblique costulato-striata, sericea, diaphana, saturate rubro-castanea, spira turrita, sutura impressa, apice acutiusculo; anfractibus 8, convexiusculis, ultimo antice subascendente, carina basali, compressa, prominente, subfuniculata, antice non dilatata; apertura subcirculari, obliqua, sursum spectante, peristomate duplici, incrassato, saturate fusco-aurantiaco, interno continuo, breviter adnato, externo fornicatim patente reflexo, superne et ad columellam subauriculato-dilatato, canali basali aperto, intus vix strictiore, ad sinistram perforato: operculo spiraliter laminato, anfractus multos appressos reconditos exhibente, facie exteriori anfractos plures angustos mentiente.
Diam. $13\frac{1}{2}$, alt. 25 mill.
Hab. ad Heneratgodde in rimis saxorum.

Allied in form and size to *Cataulus pyramidatus,* Pfeiffer, but differs in sculpture, position of the canal, colour of aperture, &c. It was taken by Mr. Edgar L. Layard in the deep fissure of a limestone rock, among the vegetable mould, where it lay concealed under the surface, with the mouth downwards, among the roots of an ancient *Ficus Indica.* In some specimens the last whorl is more swollen than in others.

Mr. Layard has communicated the following description of the animal in a letter written on the spot:—

"The animal is dark brown, mottled, about 9 lines long, 5 broad; tentacles two, brilliant scarlet tipped with brown, 3 lines long, sharp-pointed; eyes two, black, situated at the outside of the tentacles. The mollusk is very slow in its motions, crawling with the shell plane over its back, resting on the operculum; this is round and fits into the mouth; it is retractile when the animal is much irritated, but does not close the siphon and canal; when crawling, the flesh of the mollusk does not touch the canal. After placing them in boiling water to clean, I thrust a needle into one and pierced the operculum accidentally; judge of my astonishment, when in attempting to withdraw the instrument, the operculum unfolded revolution after revolution till I counted nine!" Subsequently Mr. Layard counted nineteen whorls in one operculum; and he has aptly likened it to the horn toy, made to resemble a snake by slicing it spirally from end to end, so as to form a laminar centreless screw.

At the request of the discoverer, I have much pleasure in dedicating the species to his brother, the enterprising Oriental archæologist and traveller Dr. Austen Layard.

17. *Cataulus decorus*, nobis.

Testa subperforata, elongato-turrita, solida, confertim costulato-striata, nitidiuscula, rufo-castanea, apice acutiusculo; anfractibus 8, convexiusculis, ultimo ad basin compresso-carinato, carina valde prominente, versus marginem funiculata, incrassata, antice vix dilatata; apertura verticali, circulari, peristomate incrassato, reflexo, breviter adnato, læte aurantiaco, ad basin subproducto, deorsum recedente; canali extus lato perforato; periomphalo magno: operculo ut in præcedente.

Diam. vix 10, axis 21 mill.

Hab. ad Ratnapoora.

Mr. Layard wrote regarding this species—"This was found under a rock with two others; animal brownish gray, foot livid. Tentacles pale orange, two; eyes sessile, two, black."

Mr. Layard has, since his return to England, detected in the operculum of *Megalomastoma altum* a structure similar to that which obtains in these *Catauli*, and I have, since the communication of that circumstance, also observed it in the operculum of the Himalayan *Meg. funiculatum*, nobis.

18. *Cyclophorus Parapsis*, nobis.

Testa late et perspective umbilicata, orbiculato-depressa, tenui, confertim striatula, olivacea, sub epidermide tenui albida; spira planiuscula, apice vix prominulo, sutura profunda; anfractibus 4 convexiusculis, ultimo cylindrico, leviter descendente, non dilatato; apertura subverticali, subcirculari, intus glaucescente; peristomate

continuo, breviter adnato, recto, simplice, acuto: operculo tenui, corneo, arcte spirato, medio concaviusculo, intus obtuse umbonali. Diam. major 13, minor 10, alt. 5 mill.
Hab. ad Damboul, ad verticem rupis, in rimis saxorum.

It differs from *C. loxostoma*, Pfeiffer (a large and handsomely marked variety of which was found on the same rock), in colouring, epidermis, depth of suture, narrower and deeper umbilicus, and the more circular and vertical aperture, which exhibits nothing of the diagonal departure from the axis observable in Pfeiffer's shell. The peristome also is acute and single, instead of being double, slightly expanded and thickened, as in that species, of which Mr. Layard's specimen is variegated with radiate and undulated chestnut stripes, and with a single band on a fulvous ground.

London, June 1853.

X.—*Notes on the Ornithology of Ceylon, collected during an eight years' residence in the Island.* By Edgar Leopold Layard, C.C.S.

To the Editors of the Annals of Natural History.

Gentlemen,

Should you deem the accompanying notes on the birds of Ceylon worthy of a place in your Journal, they are at your disposal. I flatter myself that they will be found to contain a complete list of those birds as yet discovered in Ceylon. I have had the advantage of consulting with Mr. Blyth and Drs. Templeton and Kelaart, with each of whom I have been on terms of the closest intimacy, and we mutually communicated our discoveries. I have myself seen and shot most of the birds enumerated, in their native haunts, for whether walking, driving or riding, I always carried my telescope and collecting gun, and I have thus traversed the greater part of the island. Besides travelling, I have been some years stationed in the widely separated localities of Colombo, and Pt. Pedro in the neighbourhood of Jaffna, from which places I made frequent excursions into the jungle, for the purpose of collecting and observing the habits of birds and animals. The only parts I have left unvisited are Nuwera Elia and Batticaloa and their vicinities. In the former place Dr. Kelaart long resided and carefully investigated, as his list shows. From Batticaloa I have inspected small collections of birds; and the only part of Ceylon entirely unknown to either of us three is the Park country, which I had hoped to explore, but was pre-

vented by the malady which has caused my return to England. I may add, I have never admitted the *native* name of a bird, until, by repeatedly questioning different and unconnected parties, I have assured myself of its correctness. The classification and nomenclature I have adopted from Dr. Gray's Catalogue of the Birds in the British Museum, and the identification of the specimens has been made by my kind friend Mr. Blyth, of the Hon. East India Company's Museum in Calcutta.

The list numbers upwards of 300 species, and will be succeeded, if you approve of it, by a similar list of the terrestrial and fluviatile Mollusca.

1. Aquila Bonellii, Temm.

This eagle was procured by R. Templeton, Esq., R.A., several years ago, and I do not know from what part of the island it was obtained. It has not fallen under my notice, nor has Dr. Kelaart enumerated it amongst his acquisitions at Nuwera Elia; I can therefore say nothing of its habits.

2. Aquila pennata, Gmel.

I shot the only specimen of this small eagle yet seen in the island, on an open plain near Pt. Pedro. I was awaiting the return of my carriage from Warrany, and took shelter from the heavy morning dew (it was scarcely daylight) under an old Bo-tree (*Ficus religiosa*), when my attention was caught by the evolutions of what I took for an immature specimen of our common fish hawk, *Haliastur Indus*. It struck me the flight was *rather* different, but this I attributed to the darkness of the hour. Suddenly it pounced upon a bulbul roosting in an oleander bush: this at once undeceived me, and as it rose with its victim in its claws, I fired and brought it to the ground. It fought with determined spirit and kept a small terrier at bay, till I killed it with the butt-end of my gun.

3. Spizaëtus Nipalensis, Hodgs.

Dr. Kelaart procured this noble bird near Badulla, at an elevation of some 4000 feet. I know nothing of its habits, as it never fell under my notice.

4. Spizaëtus Limnaëtus, Horsf.

This species is common and widely distributed. I have shot it at Hambantotte, Matura, Colombo, Pt. Pedro, and in the Anooradapoora Wanny; I have also observed it at Ratnapoora and Ambegamoa, and Dr. Kelaart obtained it at Nuwera Elia. It is a bold and daring bird, striking fowls before the doors, even

of European houses, and in one instance I knew it to enter a verandah. I had wounded a fine adult specimen of the little common *Accipiter badius*, and desirous of preserving it alive, chained it to a post in the deep double verandah of the old Magistracy at Pt. Pedro. This bird had become quite tame, when one morning going into the verandah to speak to a friend who sat there sipping his coffee, I found my favourite in the claws of the Crested eagle. The spoiler fixed his eyes upon me, and merely tried to draw his prey further away, but this the chain prevented. He then raised his crest as if to intimidate us; I hastened into the house for my gun, my friend still looking on, and when I returned to the verandah the eagle was still there. I aimed at him, but the gun hung fire, and he escaped, but not till he had nearly devoured his own kindred,—a practical refutation of the old saw, that "hawks will not pick out hawks' een." There is a singularly dark variety of this species, which I have only seen at Pt. Pedro, and that but very rarely.

5. Ictinaëtus Malaiënsis, Rein.

Dr. Kelaart procured this species at Nuwera Elia, and Mr. Mitford sent me a specimen from Ratnapoora. I subsequently saw it at Gillymally at the foot of Adam's Peak, and if I mistake not, I also observed it on the wing in the "Pasdoom Corle." It is certainly a mountain species, and I should say not uncommon, but I know nothing of its œconomy.

6. Hæmatornis Cheela, Lath. *Cudoombien*, Mal.

Abundantly and widely distributed throughout the island, this fierce and gloomy tyrant of the woods lies in wait for its prey in the gloaming, scaring the herd-boy from the tank side, or the lonely native threading his way through the jungle, by its doleful moanings. By many it is considered equally ill-omened with the dreaded *Ulama*, whose shriek is deemed the precursor of death by the superstitious native. *H. Cheela* frequents the borders of tanks and morasses, feeding on frogs, snakes, lizards, and occasionally, I suspect, on mud-fish. Concealed in the dark foliage of some overhanging tree, it heedlessly marks the smaller frogs approach the grassy margin of the pool. Suddenly the large green bull-frog (*Rana Malabarica*) uplifts its head and utters its booming call. The *Cheela* is now all attention—with outstretched neck it fixes its glaring eyeballs on its desired prey—lower and lower it bends; for the frog, which has now reached the sedges with a croak of triumph, gains a log. But a shadow glides over him—in vain he crouches—and his colour becomes a dull brown, so closely resembling the log, that human eyes would

take him for a knot in the decaying timber; with noiseless rapidity the barred wings pass on, and the log is untenanted. Fast clutched in the talons of his merciless foe, the frog is borne to the well-known perch, and a sharp blow on the back of the head from the bill of the bird deprives it of life. *H. Cheela* builds its nest in the recesses of the forest, or lofty trees. The structure is a mass of sticks piled together and added to year by year. The eggs, generally two in number, are 3 inches in length by 2 in diameter, of a dirty chalk-white, minutely freckled at the obtuse end with black dots.

7. Hæmatornis spilogaster, Blyth.

This new *Hæmatornis* was sent to Mr. Blyth both by Dr. Kelaart and myself about the same time; the Doctor procured his specimen at Trincomalee, whilst I killed mine in the Wanny. I afterwards shot another pair at Pt. Pedro. I presume they are migratory like *H. Cheela*, which visits us in the north about March and leaves in July. All the specimens were shot in one year. I know nothing of their œconomy.

8. Pontoaëtus leucogaster, Gmel. *Cadal ala*, Mal.; lit. Sea Eagle.

The "fish eagle" is not uncommon, but local, the same pair frequenting the same eyrie year after year, and adding to its nest every breeding season, until a vast accumulation of sticks in some aged Bo-tree reveals the roosting place of the adult birds: to this they nightly repair. During the season of incubation the female is very fierce, defending her nest vigorously against intrusion. The superstitious fears of the natives also operate in her defence, as the sanctity of the tree (always dedicated to some dæmon) prevents any adventurous youth from climbing it even for pecuniary reward. The flight of this species is noble and imposing: poised high over the resounding surge it wheels above on circling pinions, and with extended neck surveys the finny tribes. Here, shoals of beak-nosed fishes swim in their seasonal migrations along the coral reef; there, brilliant Chætodons float in the shallows. The tide has partially receded, and the water lies in still crystal pools in the depressions of the reef: over one of these the fish eagle passes: an abrupt wheel shows his attention arrested, a moment's pause, and down he plunges, his body swaying to and fro. The surface is reached, the legs suddenly thrown out, and with exulting cries he soars aloft, bearing in his talons a writhing snake, eel or large fish. The efforts of the bird to secure its prey in a proper position are now curious. If a fish is captured, the feat is comparatively easy; the talons of the

hawk are gradually shifted until one grasps the prey near the gills and the other near the tail, so as to bring the fish into line with its own body, thus offering the smallest surface for the impinging of the atmosphere. With a snake or eel the matter is more difficult, and I have often seen the prey free itself from its captor by its strong writhings; a bite, however, near the head destroys its power, and it is borne away dangling by the neck in the grasp of its destroyer.

9. Pontoaëtus ichthyaëtus, Horsf.

I encountered this species in the Wanny, where a pair may be generally found located by any good-sized piece of water. I found many nests in such situations, but believe the season for incubation had not commenced when I visited the locality in April. The eyrie is usually on some towering monarch of the woods overlooking the tank where the parent birds find a sufficient store of fish, frogs, and snakes, for themselves and their offspring.

10. Haliastur Indus, Bodd. *Chem prandu,* Mal.; lit. Red Hawk. *Brimalgumoitu,* Port.

Common along the whole seaboard of the island, particularly at the mouths of rivers, and in estuaries, preying on carrion, for which it contends with the crows and the black kite (*Milvus ater*); I have known it to seize a fowl, but this is an unusual occurrence. They build in the vicinity of water, making many false nests in the same tree before they finally fix upon one which pleases them; and whilst the female is incubating, the male occupies one of those first made. The nest, like that of *Blagrus leucogaster,* is composed of sticks and twigs without any lining. Eggs about 2 inches in length by $1\frac{1}{2}$ in diameter, colour dull dirty white, dotted at the thick end with bloody-coloured, unequal and uncertain small blotches and spots; in some instances these spots are nearly black, resembling dry blood. The young, of which there are generally two, are excluded about the first week in February, incubation lasting about three weeks. Before the appearance of their feathers they are covered with a grayish down, and apparently fed with soft reptiles.

11. Falco peregrinus, Linn.

This bird is doubtless very rare; the only three specimens procured I shot in January, on the open plains near Wally Bridge in the Jaffna district. I found them breeding in a palmirah tope on the left-hand side of the road from Jaffna to Pt. Pedro; the nest, a rough structure of sticks laid on the dead "*matties*" or fronds of the palmirah, from which the leafy parts had been cut

away. They feed on the small waders which frequent the borders of the salt pans. I shot the first specimen (a male) early in the month, but the female was so shy, that though I long remained concealed near the nest, she never afforded me a shot, and I was obliged to return home without her. I was surprised to find another male on the same nest when I revisited the spot at the end of the month, and procured both him and his mate with a double shot.

12. Falco peregrinator, Sund.

I was sitting late one evening in a native hut in Gillymally, at the foot of Adam's Peak, when Muttoo (my factotum bird-stuffer, hunter, and horsekeeper) came to tell me that a huge swift (*Acanthylis caudacuta*) which I had long desired to procure was sitting on a leafless tree crowning the summit of the hill, under which the hut was built. Hurrying out with the guns, Muttoo and I were about to scale the hill, when I saw something fall from the perch on which sat the bird, which I also mistook for a swift, so much did its wings overlap its tail. I directed the telescope, which I always carry, towards the bird, and to my surprise, the hour being so late, perceived a hawk (entirely new to the Ceylon fauna) devouring a small thrush. By this time Muttoo, unperceived, had approached within gun-shot of the lovely bird, and I saw the long barrel of my collecting gun slowly emerge from a favouring bush: an instant and the deadly tube was steady, the next its tiny flame burst forth, and ere the ringing report died away, the bird lay dead at the foot of the tree. This is the only instance in which the bird has been seen in Ceylon.

13. Tinnunculus alaudarius, Briss. *Wallooru*, Mal.

This bold little hawk is common throughout the island on all open plains dotted with jungle. They generally hunt in couples, sometimes skimming low over the bushes or along the ground and darting on their prey, sometimes hovering in the air and pouncing down on the larks, amadavats, and the other small birds on which they feed. I never found the nest of this species, although so abundant.

14. Hypotriorchis chicquera, Shaw.

I saw this pretty hawk in the flat country near Pt. Pedro, but could not get a shot at it. I cannot, however, be mistaken in the bird, as I long watched it with my telescope.

15. Baza lophotes, Temm.

This bird, though rare in Ceylon, appears to be widely distri-

buted, and to feed on various substances. I shot one at Jaffna with half a lizard, *Calotes viridis,* in its maw, and Mr. Mitford procured another at Ratnapoora feeding on bees, which it captured sometimes on the wing and sometimes by darting at the nest. It was attended by its mate, and the two sat together on the dead branches of a tree, raising and depressing their crests.

16. Milvus Govinda, Sykes. *Para prandu,* Mal., lit. Pariah Kite; and *Calu prandu,* Mal., lit. Black Kite, in contradistinction to *Chem prandu,* the Red Kite, *H. Indus.*

The greatest resort of this species is the estuary ignorantly called the "Jaffna Lake," and the shallow bay of Calpentyn. On the large extent of mud left bare by the receding tide, the "black kites" of Europeans find abundance of genial food, consisting of all kinds of dead fish, mollusca, and decaying animal matter, which they seize with their claws, darting from a great height. Nor do they confine their attention to the lonely seashore. Fighting with the pariah dogs, they play the part of scavengers in the filthy native towns, and early in the morning before the streets are tenanted they earn an *honest* livelihood. They are, however, bold enough to make frequent depredations on the fish-stalls, and in one instance I saw a lad about thirteen years old struck to the ground by the sudden pounce of a kite, who bore off a good-sized fish from a basket the boy was carrying on his head.

But their great feast is when the returning fleet of fishing-boats are lightened of their scaly cargo, or when the well-filled nets are drawn on shore. High overhead with quivering cry sail the "black kite," its usual companion the "red kite," and often the "sea eagle," *Blagrus leucogaster*; below, the beach is strewed with fish, crabs, turtle, cuttle-fish, &c. As the fishermen unload their boats, naked urchins catch up perhaps a gaudy Chætodon, or perhaps a strangely-shaped fish with an under jaw projecting far beyond the upper; the pariah dogs prowl about and steal a piece of shark, or nip off the head of a cat-fish; whilst the kites now rising, now falling, cull their favourite morsels in the way of Cephalopods and garbage of all kinds. I have often watched some fifty or sixty thus engaged, when the smell of fish drying in the sun for native consumption, the vociferations of the natives, and the quarrelling of children and dogs, rendered the scene one never to be forgotten.

The black kite builds in similar situations to the red kite, and lays two eggs of a rather rounder form, marked with a band of minute brownish freckles, the band occurring sometimes at one end, sometimes at the other.

17. Elanus melanopterus, Daud.

This bird is uncommon, and but two specimens have been seen by myself or my hunter. The first I saw near Pt. Pedro and fired at it several times with dust shot, unluckily without effect; the second Muttoo killed on the Perth sugar estate on the Caltura river: he described the bird as frequenting the fences and stumps of felled trees in the cleared land. He observed it on several days in the same locality before he finally secured it. When shot, though severely wounded, it fought with great determination.

18. Astur trivirgatus, Temm.

This bold and daring bird is apparently confined to the mountainous country, where it is common, waging a destructive war against the hen-roost, unscared by the guns of Europeans and natives, who alike join in efforts to subdue it, and rarely falling a victim from its wariness and the swiftness of its attack. If the luckless hen but leads her mottled brood a short distance from the shelter of the yard in search of white ants or tempting grasshoppers, down swoops the "hill chieftain" from some towering tree or beetling rock, and despite the fury and resistance of the faithful mother, rendered fiercer by despair, the foe generally carries off one, if not two, of her family. It breeds in the holes and crevices of precipitous rocks, and when the young are captured early they are trained as hunting falcons and highly prized, selling for a large sum; I saw one at Anooradapoora in the possession of a native, who refused 3*l.* for it, though its training was not completed. By way of hoodwinking it, its master had sewn up the eyelids, running the thread through them, so as to draw the edges together at pleasure.

19. Accipiter badius.

The "*sparrow-hawk*" of Europeans is very common and widely distributed, feeding on small reptiles and birds. It has a pleasing winnowing flight, and sometimes ascends to a great altitude. I have often watched three or four wheeling round each other, ascending in circles, till the eye could scarcely follow them as minute specks in the clear æther.

20. Accipiter nisus.

Included by Dr. Kelaart in his Catalogue of Ceylon birds (sed non vidi).

21. Circus Swainsonii.

Not uncommon on open plains, frequenting paddy fields and moist places in search of reptiles of all kinds, on which it feeds.

22. Circus cinerascens.

Abundant in the same localities as the preceding, and often mistaken for it on the wing. Its chief food consists of snakes, which it seizes in its claws in its low skimming flight. The prey, clutched as often from the water as from the land, is grasped by the neck and bitten across the head.

Nothing can exceed in gracefulness the flight of this bird when beating over the ground in search of its quarry. Its long pointed wings smoothly and silently cut the air; now raised high over its back, as the bird glides along the furrows; now drawn to its sides, as it darts rapidly between the rows of standing paddy; now the wings beat the air with long and even strokes, and now extended, they support their possessor in his survey of the marsh over which he is passing. Suddenly he drops, and after a momentary halt speeds away with a snake dangling in his talons to some well-remembered stone or clod of earth, and commences his repast. I am sure these two species migrate, appearing with us about the end of the paddy harvest in great numbers. Though some few remain all the year round, I never ascertained that they bred in Ceylon, though we generally see more young than adult birds.

23. Circus melanoleucos.

The only specimen I ever saw of this bird I shot several years ago, whilst journeying over an open plain near the village of Mantotte, on the western coast. I therefore know nothing of its habits. Mr. Mitford, the District Judge of Ratnapoora, has figured it amongst his spirited and truthful drawings of birds procured near that place. The bird was brought to him by a native.

24. Athene castanotus, Blyth. *Punchy bassa,* Cing.; lit. "Small Owl" (the name for all Owls is "*Bassa*" in Cingalese).

This handsome little owl was not uncommon last year in the neighbourhood of Colombo, but for nine years previously only one specimen had been procured. I also found it at Ratnapoora and Gillymally. Its hoot is not unlike the cry of the cuckoo, though more shrill and abrupt; indeed when I first heard it one morning, I thought it was the note of our annual visitor the European cuckoo. It hoots as late as 9 or 10 o'clock in the morning in shady situations; is silent during the heat and glare of the day, but begins again at 4 or 5 P.M. It is most on the alert during moonlight nights, feeding on colcoptera and geckoids, securing the latter while creeping up the bark of trees, seizing them in its claws. The natives tell me they breed in

April and May, nestling in hollow trees and the crevices of rocks. The iris of this species is red-brown, and it sees very clearly by day, being even then most difficult of approach.

25. Athene scutellata, Raffles. *Punchy bassa,* Cing.

Like the preceding, this species was either very rare, or curiously eluded the observation of both Dr. Templeton and myself for a long period; indeed I was nearly eight years in Ceylon before I saw a single specimen. One brilliant moonlight night, however, in November last, I heard as I supposed the lowing note of the "*bronze-winged pigeon*" (*Chalcophaps indicus*); thinking it very unusual at this time of night, I stopped my buggy to listen. Muttoo, too, heard the sound and declared it was a dove; but a second call undeceived me, though Muttoo still averred it was "*praa chattam*" (dove's noise). As I was dressed too conspicuously in white, I gave him the little gun and desired him to shoot the bird in question, promising sixpence if he succeeded. Muttoo slipped off his syce's dress and plunged into the cinnamon bushes, where I soon heard him imitating the call; on this the bird flew to the tree where Muttoo was concealed, and he, seeing where the bird alighted, fired and killed it. On dissection it proved to be a female with the ovaries distended with eggs, consequently I imagine the breeding season was near; the stomach contained remnants of coleoptera only. Most of our nocturnal birds of prey are insect-feeders; indeed this is not surprising from the great rarity of small mammals; they are never seen, as in England, hunting over the meadows in search of field-mice, shrews, &c. The irides of *A. scutellata* are dark greenish yellow.

26. Ephialtes scops, Linn.

Included by Dr. Kelaart in his list of Ceylon birds (sed non vidi).

27. Ephialtes sunia, Hodgs.

Procured at Nuwera Elia by Dr. Kelaart.

28. Ephialtes Lempijii, Horsf. *Punchy bassa,* Cing. *Motu,* Mal. *Koorooi,* Port.

Very common and widely distributed. I have killed both varieties in Jaffna, Kandy, Colombo, Ratnapoora, and Hambantotte. During moonlight nights it hunts about blossoming trees for coleoptera, which it catches by darting at them passing and repassing, or resting on the leaves and flowers. Their cry when at rest is a monotonous and melancholy "wāgh wāgh;" when flying it is changed to "wăh-hā wăh-hā," quickly uttered

and mingled with a tremulous cry. It breeds in February, nestling in hollow trees, and laying from two to four roundish white eggs.

29. Ketupa Ceylonensis, Gmel. *Baccamooney,* Cing. *Oomuttanloovey,* Mal.

These large owls are common through the island, both in the interior and on the sea-coast. They feed much upon fish, which they catch in the shallow mountain rivulets during moonlight nights. I have several times had them alive, and they devoured fish with avidity. When alarmed during the day, they utter a loud hissing note subsiding into a low growl; during this time the throat is much inflated at the white spot. I hear that they breed in hollow trees and clefts of rock, laying two large white eggs.

30. Syrnium Indrani, Gray. *Oōlama,* Cing.

Inhabits dense and lonely jungles, and utters the most doleful cries, which the natives (a very superstitious race) consider the sure tokens of approaching evil.

31. Strix Javanica, Gmel.

The only locality in Ceylon for this bird is the pretty fort of Jaffna. Here several pairs may be nightly seen perched on the gables of the old Dutch church, or on the dilapidated bastions of the walls. They feed much on fish, which they capture in the shallow water of the estuary commanded by the fort.

[To be continued.]

XI.—*On the* Rissoa rubra. By William Clark, Esq.

To the Editors of the Annals of Natural History.

Gentlemen, Exmouth, June 26, 1853.

It is stated in a paper of mine on the *Rissoæ* in the 'Annals,' vol. x. p. 262. N. S., "that the *R. rubra* is very common alive in certain localities, and that I have never seen the animal, and can scarcely believe it to be a true *Rissoa*, as the semitestaceous operculum and its apophysis are more like those of a *Chemnitzia*."

This view is corroborated by the reception this day, by favour of Mr. Barlee, of many lively specimens sent from Penzance in a bottle of sea-water by post, which has enabled me to get notes of all the organs. I am not aware that this curious, I may almost say, anomalous species, has ever been mentioned beyond a very slight notice by one or two authors, which in most respects

is so discordant with the animal now presented, that one would almost think some other had been inadvertently observed; perhaps a young example of the more tumid red-brown variety of the *Rissoa ulvæ*. I judge so, because authors describe their animal with very *long* and *setaceous* tentacula, whereas the true *Rissoa rubra* has those organs *particularly short and smooth*. M. Philippi's account is the best, but sadly deficient in the principal peculiarities of the animal. I think malacologists will be glad of a somewhat enlarged description.

Barleeia rubra, nobis.

Rissoa rubra, auct.

Shell.—The colour is plain red-brown, smooth or slightly wrinkled, of $4\frac{1}{2}$ to $5\frac{1}{2}$ tumid volutions, which form a rapidly increasing cone. Aperture oval, entire, contracted above, rounded basally, outer margin sharp, without the callous pad of the *Rissoæ*. Axis $\frac{1}{10}$th, diameter $\frac{1}{17}$th of an inch.

Animal.—The mantle is plain, even with the margin of the shell, and without the filament seen at the upper angle of the aperture in many of the *Rissoæ*. Rostrum very short, not corrugated nor capable of much extension, brindled above with dark smoke-coloured, fine irregular close-set lines, below of pale yellow; buccal disk of the same colour, of small area, crosially and vertically cloven, containing the usual masticatory processes of the *Littorinidæ*; neck dark, but not so much so as the rostrum, quite plain and without appendages. Tentacula very short, strong, broad, not in the least setaceous, with perfectly rounded somewhat spatulate extremities; they are not vibrated on the march: colour very pale yellowish white, with a line of sulphur-coloured beads or minute flakes running centrally from base to point: eyes very large, black, fixed on bright sulphur inflations at the external bases. Foot an elongated, rather narrow oval, rounded anteally, labiated, with scarcely perceptible auricular points, posteally rounded, emarginate in the centre of its termination; colour in the middle of the upper part confused flake-white, margined with a belt of pale smoke hue; sole pale yellow, with a decided depressed longitudinal line on the centre of the posterior half, not constricted under the slight auricles as in *Rissoa*, and not so slender; the operculigerous lobe is small, very little alated anteriorly, but expands below into a dark, flat, arcuated membrane; no cirrhus is visible, and I believe none exists; it carries a strong red-brown suboval testaceous operculum, sharp above, rounded below and at the outer edge, and straighter on the columellar side. The structure of the fine striæ on the upper surface is of subannular figure, with a longi-

tudinal furrow about the middle, which forms a raised rib on the under part, the whole of that area being thick, coarse and irregular, with, at the nucleus, which is nearer the base than the centre, a long, strong-pointed testaceous apophysis, more prominent but not so medial as in *Jeffreysia*, but stronger and longer; indeed as much so as in some of the *Chemnitziæ*.

These animals inhabit the lower littoral levels at Penzance, their locomotion is deliberate, and they evince considerable shyness. There are many fasciated varieties and a white one.

This animal nearly approaches the littorinidan group, and conducts from *Rissoa* to *Jeffreysia*: as the latter and it have analogous subtestaceous opercula and apophyses, they naturally lead to the *Pyramidellidæ*. But this species cannot be placed in *Rissoa* on account of the singular operculum, as the like is not seen in any other species of that genus, and for many other animal discrepancies. Philippi unaccountably omits all mention of the principal peculiarity, the curious operculum, but he does say that the animal departs somewhat from those he has examined, both as regards the organs and the shell; and I add, that with the exception of the very short muzzle and depressed line in the after-part of the foot, there is not another external organ that has much concordance with the typical *Rissoæ*.

Neither can it be associated with *Jeffreysia*, which, indeed, agrees with it, essentially, in respect of the operculum, but the animals of the two are very different. I shall therefore propose for it a new genus, which ought, I think, with *Jeffreysia*, to form a family intermediate to the *Littorinidæ* and *Pyramidellidæ*. I have omitted to mention that M. D'Orbigny's subgenus *Rissoina* cannot receive it, as with a testaceous operculum and apophysis, it is of the spiral or littorinidan type, whilst the present object is of subannular elements; and I consider the operculum, though so much neglected, to afford a most important generic and differential diagnosis; but independent of these points, I could not, agreeably to my views, accord with such an allocation. I repudiate all *subgenera*, which I consider as an awkward attempt to define what is undefinable—an intermediate condition between a genus and a species. I think, when a species is so discordant with the generic type, that it ought to merge elsewhere, and take on a substantive capacity and become the type of a new genus; but there can be no objection to the term *sub* when used adjectively to qualify a word, as subannular, subrotund, and subsymmetrical, &c., but not substantively, as then it becomes the source of innumerable absurdities; therefore with me a genus has no intermediate state beyond species and their varieties. I have mentioned these views in the last paragraph of a former paper in the 'Annals,' vol. vi. p. 29. N. S.

I would therefore now submit to malacologists, as I have shown that no existing genus can with propriety receive this curious creature, that a new one be constituted for it, and entitled *Barleeia*, as a just recollection of the exertions of a gentleman who loses no opportunity of enriching science with living objects from the Great Book of Nature; and though the present animal is locally common, it is malacologically an almost unrecorded rarity. We may all blush for our carelessness in not noticing this interesting and unique species, which, though within the range of many naturalists, would still probably have remained in obscurity if it had not been *déterré* and forced into notice by our invaluable friend.

I am, Gentlemen,

Your most obedient servant,

William Clark.

P.S.—Errata in the paper on the genus *Truncatella* in the last July 'Annals:'—vol. xii. p. 7. line 24, for *branchial*, read *œsophageal* streamlets. And ibid, p. 6, for Della Chiaje, read Delle Chiaje.

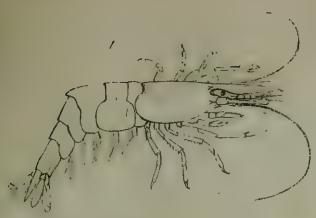
XII.—*Description of several new species of British Crustacea.* By William Thompson, Esq.

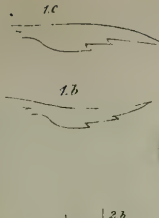
[With a Plate.]

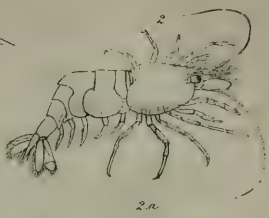
Hippolyte Whitei (mihi). *White's Hippolyte.* Pl. VI. fig. 1.

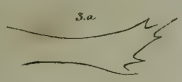
Spec. Char. Rostrum (fig. 1 *a*) straight, without spines above, and slightly bifid at the apex, beneath with a sharp two-toothed carina, and a minute one near the apex; internal antennæ with the thick filament much-curved.

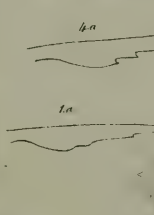
The carapace of this species is more gracile than any other of the genus, and even more slender than in the genus *Palæmon*; it is terminated by a straight and elongated rostrum, without any spine on its upper side; the apex is rather blunt; beneath there is a short carina, which is deepish, and has two teeth: there is besides a very minute tooth close to the apex, which gives the apex the appearance of being bifid; it is, however, not the case, the apex being quite distinct from the spine, which is placed on the lower edge of the rostrum; there is also a small tooth on each side of the base of the rostrum, just over the inner edge of the orbit, and another spine on each side the carapace in a line underneath the antennæ. The scale of the external antennæ is large, longer than the rostrum; its external

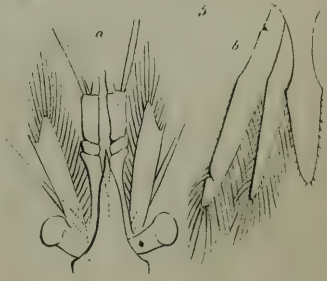












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tooth is placed at the distance of about one-fourth the length from the extremity. The thicker filament of the internal antennæ is large, and more curved than in *H. varians*.

Abdomen slender, not at all gibbous, much compressed. Last joint of fourth leg jagged on the inner margin. Two long slender spines at the base of the antennæ. External antennæ nearly the length of the animal. Length $1\frac{2}{3}$ inch.

Colour a lovely dark meadow green, with, whilst alive, a whitish band running down the carapace; one specimen only out of thirty or forty differed, and that was of a flesh-colour. Middle plate of the tail acute, with two pair of minute spines, one pair on each margin.

I took this species for the first time on the 4th of May. I obtained others on the 30th of May, and carrying ova on the 14th of June; the ova appear of a yellowish colour, but as they did not reach below the scales of the abdomen, I did not examine them as I could wish.

I obtained my specimens in four to six fathom water in a weed bed, on a stony bottom, in Weymouth Bay.

This species is exceedingly like *Hippolyte varians*; it is, however, of a much lovelier form and colour. Though larger, it is far more slender than any of the genus.

The main points of difference with *H. varians* are, that the rostrum is more elongated, not so acute at the apex, has no spine on the ridge, and has a minute spine very near the apex on the under side, thus making three spines on the under side. The spines on the carapace are much shorter. The carapace is less gibbous. The scale of the external antennæ is longer and narnower, and the spine is nearer the extremity. The thick filament of the internal antennæ is stouter and more bent, and the animal is larger.

They are more difficult to keep in confinement than many others, and far less lively.

Some I had spent the whole of their time clinging to the fronds of a piece of *Furcellaria fastigiata*, lying the length of the frond, and not across it; and however often I disturbed them, they invariably found their way back.

I have named this species after Mr. Adam White, one of the Assistants at the British Museum.

I have just had some more specimens brought me, amongst which I find one with the rostrum much turned up (fig. 1 *b*),—quite as much so as in *Palæmon varians*;—two with the rostrum curved very much downwards (fig. 1 *c*), giving them a most extraordinary appearance; these I consider provisionally, until I obtain other specimens, as varieties of *H. Whitei*; I propose to name the first *H. Whitei* (var. *ensis*), and the second *H. Whitei*

(var. *falcatus*): should I obtain evidence of their being distinct species, the specific names will then be probably changed.

I now find that some few specimens of *H. Whitei* are of a brownish colour; these had been brought home in a brass box.

HIPPOLYTE YARRELLII (mihi). *Yarrell's Hippolyte.*
Pl. VI. fig. 2.

Spec. Char. Rostrum (fig. 2 *a*) short, bent downwards, incurved at the base, hollowed out above, with four spinous teeth above. The apex tridentate, the upper tooth the longest, the middle tooth longer than the lower one.

The carapace is short and rounded; the rostrum short, bent downwards, and suddenly widening near the apex, armed above with four spinous teeth bent forwards at an acute angle; the first, which is not very prominent, is placed on the carapace at the base of the carina, which forms the continuation of the rostrum; the second immediately in a line with the ocular notch; the third, which is the longest, is placed in a line over the middle of the peduncle of the eye when the eye is directed forward; and the fourth is placed on the rostrum, and about twice its own length from the apex. The upper edge of the rostrum is much hollowed out; the lower edge of the rostrum is straight, with an inclination downwards, unarmed, and ending in an acute angle. The apex is deep and tridentate; it is formed of the tooth just described, and two others projecting beyond it. The upper tooth is longer than the second and slightly inflected; the second is very acute, and longer than the bottom, which appears to be formed by a portion being scooped out. The two upper teeth bend upwards, whilst the bottom bends slightly downwards; this widens the apex.

The scale of the external antennæ extends to more than half the length of the filaments of the internal antennæ. Marginal tooth terminal, not so long as in *H. Cranchii*. Anterior feet extending forwards a little beyond the antennal scale; second pair with the wrist long. The junction of the abdomen and thorax very gibbous.

The process on the posterior margin of the third segment much more prominent, and running more to a point than in *H. Cranchii*.

The middle portion of the tail has five or six pairs of spines placed on it, and not on the margin.

Length about $\frac{3}{4}$ of an inch; colour brown, blotched with a darker or claret-colour.

I obtained two individuals whilst dredging in Weymouth Bay on the 18th of August 1852, in from five to seven fathom water, on a bed of *Rytiphlæa pinastroides*. One carried ova, which were

of a rich orange-brown. This Hippolyte in its general appearance very nearly approaches *H. Cranchii*, from which it differs in the form and number of the spines on the rostrum and at the apex, the shape of the rostrum, the shape of the third segment of the abdomen, and some other particulars.

I have ventured to name this species after Mr. Yarrell, to whose constant friendship, advice and writings, I attribute my partiality to natural history, and whose kindness at a critical age in my youth taught me to turn my leisure hours to, I hope, a good account.

HIPPOLYTE GRAYANA (mihi). *Gray's Hippolyte.* Pl. VI. fig. 3.

Spec. Char. Rostrum (fig. 3 *a*) long, hollowed out above and below; above unarmed, with the exception of one tooth near the apex; beneath with three teeth.

Carapace rather compressed and of a moderate length.

Rostrum long, the upper edge much hollowed out, and the widest part armed with a tooth a little behind the apex; this tooth is shorter than the apex, and curved downwards; the apex is acuminate, and longer than the upper tooth; the base of the teeth placed above and beneath the apex are on a line, and as they are both placed on a carina proceeding from the rostrum, it makes that portion very deep, and gives it an appearance of a tridentate rostrum.

The under side of the rostrum is also much hollowed; its least depth is immediately over the middle of the peduncle of the eye; it then gradually deepens towards the extremity until it attains the greatest depth, when it again turns up, and ends in a tooth just under the apex. It is further armed underneath with a tooth at the point of its greatest depth, and another a little in advance, thus making three teeth on the under side of the rostrum. A sharp tooth is placed over each orbit, and a second on each side of the anterior inferior portion of the carapace. Scale of the external antennæ rather narrow, long, extending beyond the filaments of the internal antennæ, with a tooth on the outer margin, at about one quarter the length of the scale from the extremity; the inner margin appears to be toothed or rather notched.

There is a peculiar process at the end of the scale; the inner margin ends with a curved spine or cilium, and the outer margin has a straight process against which the crooked one closes. I cannot determine whether they have motion or not.

Middle plate of the tail slender, tapering, with two pairs of exceedingly minute spines, only visible with a lens. Abdomen compressed, of even depth as far as the posterior edge of the

third segment, and then becoming suddenly very much contracted, and of almost equal size throughout. The process of the third segment of the abdomen is very prominent.

Colour brown with a reddish tinge in places.

Length about 10 lines.

This species is very easily distinguished by the armature of the head, form of the abdomen, and the shape and armature of the rostrum, in which it approaches no other described British species. I obtained it in four fathom water, stony bottom, Weymouth Bay.

I have named it after Dr. J. E. Gray, the Keeper of the Natural History Department of the British Museum.

HIPPOLYTE MITCHELLI (mihi). *Mitchell's Hippolyte.*
Pl. VI. fig. 4.

Spec. Char. Rostrum (fig. 4 *a*) straight, acuminate, without a spine on the upper portion; beneath with a three-toothed carina, and a small tooth near the apex.

Carapace not at all gibbous, terminated by a straight and elongated rostrum, without a tooth on its upper edge; beneath there is a short carina carrying three teeth: a small tooth is placed near the apex. A small tooth is placed each side of the base of the rostrum over the orbit. Scale of the external antennæ not very broad, but long, extending beyond the rostrum, with an external tooth, which is placed at one-fourth the length of the antennæ from the extremity.

Length 16 lines.

Colour a beautiful clear and dark green.

I obtained nine individuals from amongst a parcel of *Hippolyte Whitei* brought me on the 2nd of July, 1853.

This species at first sight might be taken for *H. Whitei*; it is, however, larger, and the teeth on the rostrum are more numerous.

I was at first disposed to consider this as only a variety of *H. Whitei*, but the fact of finding so many, and all perfectly agreeing, decided me in admitting it as a new species.

I obtained this species by dredging; none carried ova; it was taken in four to six fathom water, on a weedy and stony bottom, Weymouth Bay.

I beg to name this species after Mr. Mitchell, the indefatigable Secretary of the Zoological Gardens, and the successful promoter of the Marine Vivarium, as it is owing to the impetus given to dredging by the demand for marine life, that I am indebted for all the new species now described.

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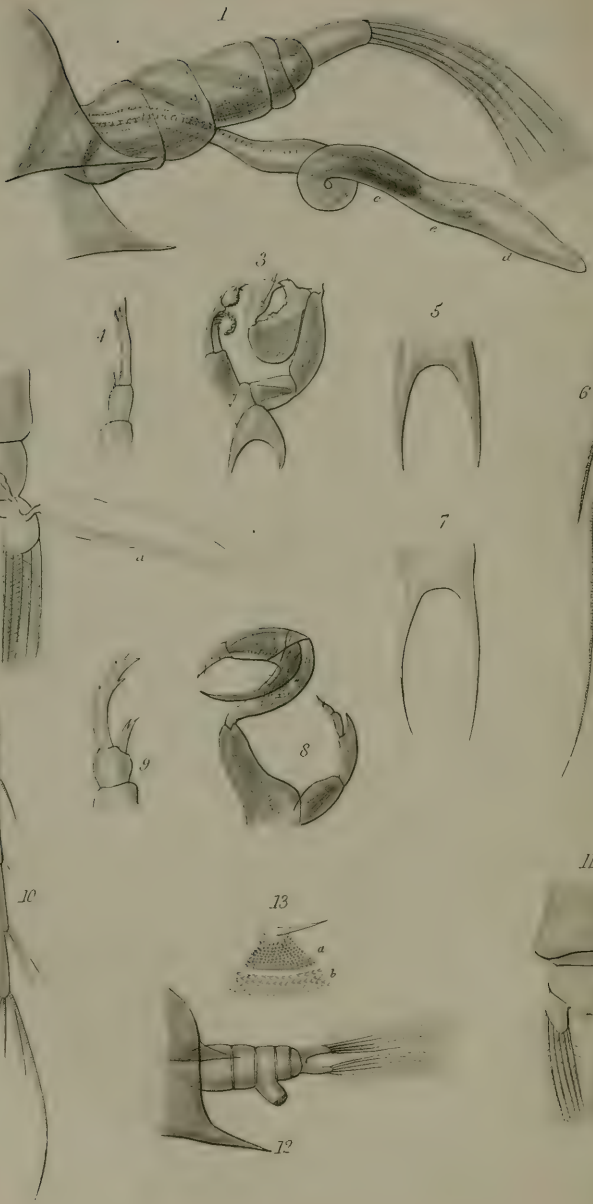

J. Lubbock del.

J. De C. Sowerby sc.

XIII.—*On two new species of* Calanidæ, *with Observations on the Spermatic Tubes of* Pontella, Diaptomus, *&c.* By John Lubbock, Esq., F.Z.S.

[With a Plate.]

When, in last March, I described the new species of *Labidocera*, which I proposed to call *L. magna*, I was only acquainted with the male, and was therefore anxious to find a female in order to complete the description of the species. This is the more necessary in the present genus, because the best specific characters are taken from the right anterior antenna of the male and the fifth pair of legs, organs which are dissimilar in the two sexes, and it is therefore evident that unless they are known in both, it would be very difficult to refer females to their respective males. Prof. Owen and Prof. Quekett, with their usual kindness, afforded me every facility, but I was unsuccessful in my search, and have never met with a second specimen. Dr. M'Donald, however, of H.M. steam-vessel Torch, has recently met with it in great numbers in the voyage from St. Vincent to Rio Janeiro, and a short description of it will be found in the Proceedings of the Royal Society for April 7, 1853. His paper is accompanied by drawings, to the beauty and general accuracy of which I can bear witness, from which it appears that the colour, as in *L. Darwinii*, is blue. *Anomalocera Patersonii*, which is the representative species in the North Atlantic, and appears to form the connecting link between *Labidocera* and *Pontella*, is also greenish blue. I think it likely that the other species are also bluish. Dr. M'Donald says, that when they were "placed in a vessel of sea-water, they rested on their antennæ on reaching the bottom, and paddled themselves about by their fore-limbs and tail." He has also an interesting observation on the superior development of the right side of the body; he "remarks that in all their movements the males exhibit a tendency to turn towards the left side, and concludes the rationale of this fact to be, that the brain on the right side being more developed at the part from which the right antenna derives its nerves, a corresponding preponderance is given to the power of the locomotive organs on that side."

Although however disappointed in my search for the females of *Labidocera magna*, I found in the same bottle two other species. The first is an aberrant species of *Pontella*, Dana, agreeing with that genus in the number of eyes, but very nearly resembling *Labidocera Darwinii* in the structure of the right male antenna, and is therefore a link between these two genera. The

second, on the other hand, is the type of a new genus which I propose to call *Monops* (μόνος, *one*; ὤψ, *eye*). It differs from *Anomalocera* in having no superior eyes; and resembles *Labidocera magna* more than any other species that I know.

I will first give short specific descriptions of all the species at present known in which the anterior antenna is provided with dentated plates; then describe the two new species at length; and finish with a few words on the classification and geographical distribution of the group, with a comparison of all the right male antennæ.

Pontella Bairdii, n. s.

Antenna antica maris dextra duabus dentatis lamellis instructa, apicali long. $\frac{1}{66}$ unc. Spina prehensili parva, rigido crini simili. Ramo interno pedis postici maris sinistri, papilloso. Pede postico fœminæ long. $\frac{1}{10}$.
Color?
Long. cir. $\frac{1}{5}$.
Hab. Atlanticum oceanum, S. Lat. 20°, Long. 0°.

Labidocera Darwinii, Lubk.

Antenna antica maris dextra duabus dentatis lamellis instructa, apicali long. $\frac{1}{100}$. Spina prehensili parva, rigido crini simili. Ramo interno pedis postici maris sinistri, annuloso. Pede postico fœminæ long. $\frac{1}{7}$.
Cæruleo-viridis, interdum fusco maculatus.
Long. cir. $\frac{1}{8}$.
Hab. Atlanticum oceanum, S. Lat. 38°, W. Long. 65°.

Labidocera Patagoniensis, Lubk.

Antenna antica maris dextra tribus dentatis lamellis instructa. Spina prehensili magna. Pede postico maris sinistro; forti, ad apicem acuto et corneo, ramum internum non gerente. Pede postico fœminæ parvo, ramum internum non gerente.
Long. cir. $\frac{1}{5}$.
Hab. Atlanticum oceanum, S. Lat. 38°, Long. 65° W.

Labidocera magna, Lubk.

Antenna antica maris dextra quatuor dentatis lamellis instructa. Spina prehensili maxima, annulosa. Pede postico maris sinistro, magno, ad apicem tumido, papilloso; ramo interno nullo.
Long. cir. $\frac{1}{4}$.
Hab. Atlanticum oceanum, S. Lat. 18° 40′, Long. 2° 30′ W.

Monops grandis, n.s.

Antenna antica maris dextra duabus magnis dentatis lamellis in-

structa. Spina prehensili magna. Pede postico maris sinistro, parvo, non ad apicem tumido, non papilloso, ramo interno nullo. Long. cir. $\frac{1}{5}$.

Hab. Atlanticum oceanum, S. Lat. 18° 22′, Long. 2° W.

Pontella Bairdii.

I now proceed to describe *P. Bairdii*, which I have so named in honour of Dr. Baird, who has done so much to increase our knowledge of the Entomostraca of this country.

This species agrees in most points very closely with *L. Darwinii*, but differs from it in having an inferior eye, besides the two superior; it belongs therefore to *Pontella*.

The cephalothorax has only six joints, the last having coalesced with the preceding. The anterior segment agrees with that of *L. Darwinii* in not having a spine directed outwards, as is the case in *L. magna* and *Patagoniensis*. The rostrum (Pl. V. fig. 5) is strong, deeply forked, and extends downwards as far as the inferior eye. Each fork is about $\frac{1}{100}$ in length, $\frac{1}{300}$ in breadth at the base, and $\frac{1}{700}$ half way down.

The superior eyes are a good deal larger in the male than in the female. In one specimen they are bright violet, but in every other specimen the colour has been entirely removed; while the inferior eye, which is also violet, has in very many instances retained its colour.

The inferior eye is situated between the anterior antennæ, it is large, and, as remarked above, dark violet. It would be impossible to overlook it, even in the most cursory examination.

I shall refer to this point again when I consider the classification.

The anterior antennæ of the female and the left antenna of the male has on the internal side of the apex of the penultimate segment a long hair $\frac{1}{66}$ of an inch in length, and the apical and antepenultimate segments have each a corresponding one $\frac{1}{99}$ of an inch in length (fig. 6).

The right antenna of the male is formed upon the same type as that of *L. Darwinii*, from which it differs chiefly in the apical plate being longer, reaching nearly to the apex of the antepenultimate segment; and in the three apical segments being more pear-shaped, with the larger end in front. In some specimens the antenna was more swollen than in others, which perhaps may be accounted for by differences of age, or by the state of development of the spermatic tube.

The second pair of antennæ $\frac{1}{31}$ in length.

The mandibles $\frac{1}{66}$ in length, and the palpus also $\frac{1}{66}$. Each lobe of the palpus has six long plumose hairs, and the inner lobe also four smaller ones.

The first pair of maxillipeds $\frac{1}{50}$.

The second pair of maxillipeds $\frac{1}{70}$. The palpus is $\frac{1}{66}$ in length, 4-jointed and tapering towards the apex; the other species of the genus have six segments to the palpus, and the joints which have disappeared are the two apical. The basal segment has a number of spines or small teeth on the inner edge. *L. magna* agrees with the present species in having also a few spines in the same place. In the arrangement and structure of the hairs, this organ agrees almost exactly with that of *L. magna*, except that the third hair has no spines above.

The third pair of mandibles $\frac{1}{40}$.

Thoracic legs. The first four pairs are adapted for swimming, as in the rest of the family, and are all alike, except that they increase in size from the first to the fourth, which are $\frac{1}{22}$ in length. The large spines on the external margin of each leg are dentated above, and accompanied by a smaller spine on each side. All the appendages, from the second pair of antennæ to the fourth pair of thoracic legs inclusive, are very similar to those of the allied species.

The fifth and last pair is very different; its use in swimming, if any, is quite subordinate to its functions connected with the act of fecundation. In the female they are smaller and simpler than in the male, and symmetrical, while in the latter they are much more complicated, stronger, and asymmetrical, the right leg being the largest and forming a prehensile apparatus.

In the present species these legs of the female (fig. 4) are much larger than in *L. Darwinii* or *Patagoniensis*, measuring $\frac{1}{40}$ in length. They most nearly resemble those of *L. Darwinii*, from which they only differ in their larger size, and in the external branch being longer and bearing three instead of two spines at the extremity.

The left leg of the male (fig. 3) consists of four joints as in the other species, but the second segment (counting from the base) appears both in this and in the corresponding right leg to be composed of two which have coalesced. It most resembles that of *L. Darwinii*, and, like it, bears two rami. I have already remarked the curious relation which appears to exist between this branch and the prehensile spine of the right male antenna, viz. that where one is developed the other disappears, and *vice versâ*. This ringed branch is homologous with the inner ramus of the other thoracic legs, like which it is two-jointed. In the present species it is long, slender, tapering, and ringed, with the rings produced into papillæ. Like the corresponding organ of *L. Darwinii* it appears to be extensible, as the length and thickness vary in different specimens. Length $\frac{1}{40}$.

The right leg, $\frac{1}{42}$ (fig. 3), also consists of four joints, but, as in

the left leg, the second (counting from the base) appears to be composed of two segments. The basal segment is attached by its external basal angle to the apex of a strong crescent-shaped process, the horns of which point inwards. The second is longer and thinner, and, as I have just noticed, appears to consist of two; it bears a strong spine at the external apical angle. The third is very strong and muscular, as in the other species of this genus; it is attached to the inner apical angle of the preceding segment. Besides the large claw at the base, which forms with the succeeding segment a prehensile apparatus, there is a smaller spine directed backwards. On the external margin, which in the ordinary position would be lowest, there are two rounded projections, of which the apical is the largest and appears to be transversely striated or furrowed. The portion which answers to the large moveable claw of the allied species is here, as in them, attached to the external apical angle of the third segment, but in the present species it gradually increases in size from the base, is produced at the apex into a large claw, which with the corresponding one of the third joint forms a prehensile apparatus, and appears to consist of three segments, of which the second and third bear a hair each, and the third a long cylindrical appendage, provided at the apex with a small spine and two hairs.

The abdomen (figs. 1 & 2) is entirely without legs. That of the male consists of four segments, terminated by two 2-jointed lamellæ, exactly as in *L. Darwinii*.

The abdomen of the female is two-jointed and swollen transversely. The right side is more swollen than the left, and bears on the back a large spine.

This appears to be the best place to mention what I have to say about the impregnation. There is a very interesting paper by Siebold in the 'Annales des Sciences Naturelles,' 1840, 2nd sér. t. xiv. p. 26, "Sur l'accouplement du *Cyclops Castor*;" and in order to make my own observations more intelligible, I shall quote a part of what he says, premising that the *Cyclops Castor* now forms the genus *Diaptomus*, and, with *Pontella*, *Cetochilus*, &c., has been separated from the old family, Cyclopidæ:—

"Ce qui passe pendant que ces animaux se tiennent ainsi embrassés est un des phénomènes les plus remarquables dans le règne animal, et dont on n'avait jamais eu une idée. Un tube cylindrique, rempli d'un liquide spermatique, s'échappe de l'ouverture sexuelle du mâle immédiatement après l'embrassement; le mâle saisit ce tube aussitôt qu'il est sorti et le colle contre le ventre de la femelle, audessous de la vulve. . . . . .

"Chacun de ces tubes spermatiques renferme trois masses bien différentes entr'elles. Une des matières contenues est blanchâtre et épaisse; elle a la propriété de ne pas se dissoudre dans

l'eau, mais de s'y transformer en une masse visqueuse et solide. Cette masse ténace, coagulable dans l'eau, s'étend dans toute la longueur de la capsule. Une des deux autres matières est composée d'une foule de très petits corps ovales et bien contournés, ayant longueur de 0·0066 à 0·0070 de ligne anglaise : ils paraissent d'une forme aplatie. La troisième masse consiste dans une foule de corps ovalaires, dont les contours sont moins bien dessinés, et qui ne sont pas clairs comme ceux-ci, et sont composés de granules très-fins. Ces deux dernières masses se trouvent reparties dans la capsule d'une manière remarquable, et forment une couche très-mince placée sur la surface interne. Les corpuscules bien limités se trouvent dans la moitié supérieure de la capsule, tandis que les corpuscules granulés, bien séparés des autres, occupent la moitié inférieure ; ces deux masses ne permettent donc pas que la portion ténace se trouve en contact avec la surface interne de la capsule. Enfin, le col de la capsule se trouve seulement rempli par de la substance visqueuse. . . . .

" Aussitôt qu'un tube spermatique bien développé se trouve en contact avec de l'eau, les corpuscules granulés se gonflent (probablement par l'imbibition de l'eau), et ces corpuscules qui composent la matière expulsive, perdent leur forme ovalaire et deviennent ronds. Peu à peu leur aspect granulé s'efface, ils se transforment en vésicules, qui s'enflent de plus en plus, et ils finissent par expulser la matière glutineuse qui se trouve vers le col ouvert de la capsule, et qui peut facilement s'échapper. . . .

" La matière expulsive continue de s'enfler, quand même la matière glutineuse a déjà quitté la capsule ; de sorte que cette matière chasse aussi tous les zoospermes, sans laisser seulement un corpuscule ovale dans la capsule. Quand tout est sorti hormis les grandes vésicules de la matière expulsive, celle-ci devient transparent comme de l'eau, et paraît composée de grandes cellules. Or, nous savons qu'avant cette transformation la capsule était blanchâtre."

In my paper on *L. Patagoniensis* I described and figured (Pl. X. fig. 2) a cylindrical appendage, situated on the *back* of the first abdominal segment, but was obliged to leave it doubtful, whether it was a spermatic tube or an external ovary, although I inclined to the former supposition. In the present species, however, I was more fortunate ; for after looking through several hundred specimens, I found a male, from which the tube was in the very act of escaping, and also four females, each of which had one attached to them. Three of these are quite empty, and evidently are homologous with the cylindrical appendage of the *L. Patagoniensis*, as they exactly agree with it in texture and general appearance, and differ only slightly in shape and in position. It is evident, therefore, that the appendage of *L. Patagoniensis* is a true spermatic tube, and is only

anomalous in being attached to the back instead of underneath. The tube which was in the act of escaping from the male still retained its contents, which agree with Siebold's description. Using his nomenclature and letters of reference, *d* is the expelling matter (matière expulsive), *e* the glutinous substance (matière glutineuse), and *c* the zoosperms (zoospermes). I have already remarked that of a large number of females which I examined, four only were provided with one of these appendages; this is probably owing to their having been collected in the middle of June. Mr. Darwin's specimens of *L. Darwinii* having been caught in November, which answers to our May, would account for my never having found a fully developed spermatic tube in that species, and the only time that Dr. Baird ever met with a tube attached to *Diaptomus* was in October.

As, owing to an accident happening to the vessel in which his specimen of *Diaptomus* was contained, Dr. Baird says, he was "prevented from making any lengthened observations on it," and as I have heard of no one else who has studied the subject, I believe my observations are the first which fully confirm those of Von Siebold. The manner in which the three substances contained in the tube act in *Pontella* is probably the same as in *Diaptomus*. Jurine says, "il n'est pas rare d'en trouver avec deux, trois, quatre, même cinq tubes spermatiques collés autour de la vulve;" I, however, never met with a female, either of *P. Bairdii* or *L. Patagoniensis*, which had more than one tube. This mode of fecundation, which Siebold has truly observed, is one of the most remarkable phænomena in the animal kingdom, has now been observed in *Diaptomus Castor*, *Labidocera Patagoniensis*, *Pontella Bairdii*, *Calanus hyperboreus* (see the figures given in Gaimard's 'Voyage en Scandinavie'), and it probably occurs also in *L. Darwinii* and *Anomalocera grandis*, n. s., because in these species, as in the *P. Bairdii*, I have found in the posterior part of the cephalothorax, an organ which I am nearly sure is a spermatic tube in the course of formation, so that it will most likely be found to prevail throughout the whole family. The shape of the tube varied in the different specimens of the same species. Since the male orifice is situated between the second and third abdominal segments, as in *Cyclops*, it is evident that the inner branch of the left posterior leg in the male is not a true penis. The delicacy of the structure of this branch appears to indicate that it possesses the sense of touch in a high degree. I have already noticed the curious relation which appears to exist between it and the prehensile spine.

Length about $\frac{1}{2}$.

Hab. Lat. 18° 15′ S., L. 2° 30′ W. to 4° E.

From the Museum of the College of Surgeons. Collected by Sir E. Home.

Genus Monops.

Rostrum furcatum. *Antenna antica* maris *dextra* geniculans, tumida. *Oculi superiores* nulli. *Oculus inferior* unicus. *Pes posticus* maris *dexter* crassus prehensilis.

These characters distinguish *Monops* from all the other genera in the family, but I shall presently give my reasons for considering this form as a new genus more at length. It is true that these are the characters of *Anomalocera* as given by Templeton, but that genus has in reality four superior eyes.

I have already given the specific character, and it is therefore unnecessary to repeat it here. In general appearance this species resembles *L. magna* more than any other species which I know, for which reason I have given it an analogous trivial name.

The cephalothorax is 7-jointed; the posterior segment is very small, the three anterior large and nearly equal to one another, the other three intermediate in size and also equal to one another. The force which has developed the right anterior antenna and the right posterior leg of the male more than the left, has had the same effect on the posterior angles of the cephalothorax; that on the right side is at least twice as long as the other. In the female they are symmetrical. The spines of the anterior segment do not project outwards, and therefore are not visible from above. The rostrum (fig. 7) is very deeply divided, and the two forks are very delicate, symmetrical, and curved towards each other. Each prong is $\frac{1}{80}$ in length, at the base $\frac{1}{1000}$, at the middle $\frac{1}{6000}$, and at the apex not more than $\frac{1}{18,000}$ in diameter. Those of *L. magna*, on the other hand, are strong and short, being only $\frac{1}{160}$ in length. (See Ann. and Mag. Ser. 2. vol. x. pl. X. f. 8).

The anterior antennæ of the female and the *left* one of the male have at the apex a very long hair $\frac{1}{30}$ in length. The corresponding hair of the penultimate segment is $\frac{1}{200}$, and of the antepenultimate $\frac{1}{250}$ (fig. 10).

The right anterior antenna of the male resembles that of *L. magna* more than that of the other species; it swells and contracts again, however, more abruptly than in that species. The prehensile spine is much smaller and not ringed. The plate belonging to the eighth segment (see the comparison of the right male antennæ in this genus) is not free at the base. The teeth are not so sharp. The eighth and ninth segments have coalesced, so that the hairs which belong to the latter appear to be situated on the former.

The sixth segment bears a very small plate with a few rather large teeth, analogous to the penultimate plate in *L. magna*. A glance at the figure will give a better idea of the general form of the organ than any description could convey.

The second pair of antennæ have thirteen long hairs at the end of the longer branch; they are $\frac{1}{33}$ of an inch in length.

The mandibles $\frac{1}{33}$. Palpus $\frac{1}{66}$. The rows of hairs which I have mentioned as present in *L. Patagoniensis* and *magna* are here much developed and form a strong brush.

First pair of maxillipeds $\frac{1}{66}$. The lobes are more divided than in the allied species. The spines on the inner edge are few in number, large, strong, curved, and clothed with short brown hairs.

Second pair of maxillipeds $\frac{1}{100}$. Palpus $\frac{1}{100}$. There are, as in *L. Patagoniensis*, seven hairs on the organ itself; the external (nearest to the palpus) small, setose on both sides; the next only half as long as the first. The next two very long, with inconspicuous hairs on the lower side. The fifth short, setose on each side, but chiefly below, the next only setose below. The internal setose on each side, but chiefly below. The last three hairs are about the same size, and half as long as the preceding. The palpus consists of four segments only, the basal and apical bearing at the apex two, the rest one hair each, all setose below.

Third pair of maxillipeds $\frac{1}{41}$. There are six of the smaller hairs plumose on each side. The larger hairs are beautifully crenate at the apex for about $\frac{1}{3}$rd of their length. The secondary spines of all the basal portion have disappeared.

Fifth pair of legs. Male (fig. 8). The left leg is much smaller than the right, and has no inner branch. The second segment has a spine externally at the apex. The third is small and bears the two tufts of hairs, and the fourth is very small, and bears at the apex a little tapering delicate lobe, which may, perhaps, be the rudiment of another segment, $\frac{1}{80}$ of an inch.

The right leg (fig. 8) also consists of four segments; the third, which in some species is so much swollen, is small, its office being probably in part transferred to the strong prehensile antenna. The fourth segment is small, and the spine of the third is very large and pointed, so that at first sight it might be mistaken for the fourth segment. The presence of two hairs on the smaller spine unmistakeably denote it to be the real homologue of the apical segment; $\frac{1}{66}$ in length when not extended.

In the *female* (fig. 9) they are $\frac{1}{38}$ in length. The inner branch bifid at the apex; the outer much-curved, also bifid at the apex, with a large spine on the inner and two very small ones on the outer side.

Abdomen. Female (fig. 11). Two-jointed, asymmetrical, the right side of the basal joint bearing a large slightly tapering lobe, about half as long as the succeeding joint.

The abdomen of the male (fig. 12) is similar to that of the

other species of the genus, except that on all my specimens there is a very short cylindrical appendage attached underneath to the third segment on the right side. A hemispherical portion at the end is very dark violet, covered with numerous small spines (fig. 13 *a*) and surrounded by a narrow light yellow border (*b*), on which they are rather larger and more scattered. There are a few hairs on the violet part. The end, therefore, resembles a hemispherical file, but I cannot offer the slightest suggestion as to its probable use. Mr. Darwin and Prof. Quekett have kindly examined it for me. The females have no such appendage.

Length about $\frac{1}{3}$.

Hab. Lat. 18° 15′ S., Long. 2° 30′ W. to 4° E.

From the Museum of the College of Surgeons. Collected by Sir E. Home.

EXPLANATION OF PLATE V.

Fig. 1. *Pontella Bairdii.* Abdomen. Male. *d.* Expelling matter. *e.* Glutinous matter. *c.* Zoosperms.
Fig. 2. Ditto. Abdomen of female, seen from above. *a.* The empty spermatic tube.
Fig. 3. Fifth pair of legs. Male.
Fig. 4. One of ditto. Female.
Fig. 5. Rostrum.
Fig. 6. Four apical segments of the normal anterior antenna.
Fig. 7. *Monops grandis.* Rostrum.
Fig. 8. Fifth pair of legs. Male.
Fig. 9. One of ditto. Female.
Fig. 10. Four apical segments of normal anterior antenna.
Fig. 11. Abdomen. Female. Seen from above.
Fig. 12. Ditto. Male. Seen from the side and below.
Fig. 13. A small piece of the dark part of the abdominal appendage of ditto.

[To be continued.]

XIV.—*Notes on some new or little-known Marine Animals.*

By P. H. Gosse, A.L.S.

To the Editors of the Annals of Natural History.

Gentlemen,

The expectation which I ventured to express in your Magazine for last October has been amply realized. Marine animals and plants *have* been exhibited in London, in their native health and beauty, in circumstances where their various functions and instincts can be carried on under the eye of the naturalist; and the inhabitants of the metropolis have enjoyed a sight of the curious

denizens of our seas, without going out of hearing of their dear Bow Bell.

What advantages to science our metropolitan zoologists have reaped from their opportunities, I leave them to record; but I propose to lay before your readers, from time to time, some notes that I have made while engaged in forming the collection. At the time of my writing these lines, about 3000 specimens of living marine animals and plants have passed through my hands, and have been successively transmitted to London for deposition in the Zoological Society's aquaria. Some of these have appeared to me as yet undescribed, others seem to be little known, except in a dried and withered state; and the great majority even of such as are considered well known, present so much of novelty and interest in their habits, that I often regret that the almost absolute absorption of my time in collecting and transmitting the specimens, forbids my jotting down a great deal of what I observe, while fresh in memory.

But without further preface I proceed to describe some new or rare species of *Invertebrata*.

Class ECHINODERMATA.

Fam. Sipunculidæ.

Sipunculus punctatissimus (mihi). The Dotted Sipunculus.

Body $1\frac{1}{2}$ inch long, $\frac{1}{8}$ in. thick; trunk $\frac{5}{8}$ in. long, $\frac{1}{20}$ in. thick. The body is cylindrical, abruptly pointed, of a satiny gloss, seen under the lens to be covered with close-set, slight, annular wrinkles. The trunk is nearly cylindrical, but slightly attenuated about the middle; it is wrinkled transversely like the body, and has in addition several irregular longitudinal furrows; the extruded tip is surrounded by about eight circles of minute black bristle-points, and terminated by a single row of short, slender filiform white tentacles, which are evertile. The general colour of the whole animal is light umber-brown, which, under a powerful lens, is resolved into a freckling of pale dots excessively minute, close-set, and numerous, on a ground of brown. I obtained it between tide-marks at Weymouth, July 1st, 1853.

Class ZOOPHYTA.

Fam. Corynidæ?

Genus Spadix (mihi). Root adhering, creeping for a short distance. Stem free, very flexible, girt near its base by a multitude of arborescent appendages, which bear berry-like ova. Upper part of stem fleshy, covered with papillæ. The name was

suggested by the resemblance which the animal bears to the spadix of an Aroideous flower with its surrounding berries.

Spadix purpurea (mihi). The Purple Spadix.

Height to $\frac{3}{4}$ths of an inch: root short, thick, yellow: ovarian branches numerous, bearing globular white ova: free stem, spindle-shaped, covered with minute purple papillæ intermingled with a few white ones.

This curious form appears to be a zoophyte of the family *Corynidæ*, or rather its affinities are closer with the members of that family than of any other that I know of. The habit, the club-shaped head, the motions, the manner in which the ova are clustered, their position, and their appearance, all point towards *Coryne*; and the papillæ may be considered as so many tentacles, representing the globe-headed organs of that genus, increased in number but reduced in development.

A semicylindrical thread of a pale yellow tint, about half a line in diameter, creeps along the surface of a stone for about $\frac{1}{6}$th of an inch, when it rises into a free stalk varying in length from $\frac{1}{4}$th to $\frac{3}{4}$ths of an inch, being very extensile and contractile. A little way above the point of contact with the stone, the stem sends forth on every side a great number of short whitish branches with a dark core, which are again set with a number of short branchlets. These processes bear the ova, which stud their surface to the number of twenty or thirty on each: they are white globules, looking like pearls, and of various sizes, some minute, others comparatively large and conspicuous. The largest are about $\frac{1}{3}$rd of a line in diameter. One that spontaneously detached itself had a depression at one part of its surface, where probably the point of connexion had been. The upper part or body of the animal is spindle-shaped or clavate, according to the degree of its extension; it is covered with minute oval papillæ, which are crowded so closely that no interspace is visible. These are for the most part of a reddish purple hue, with the tips deeper in tint, but isolated papillæ are scattered all over the body, which are quite white.

The movements of this animal are vigorous and lively, considering its stationary habit. The ovarian branches are frequently jerked about independently of each other; the free body is ever and anon tossed to and fro in the manner of *Coryne*; it is lengthened and shortened at will with suddenness and rapidity, and while the beholder is examining it with a lens, he is surprised by seeing that there is yet another movement among the papillæ, one or two of which, in various parts of the body, are now and then starting up with a jerk from their fellows into a more erect position, and then lying down again.

I first found this zoophyte at Lulworth on the 8th of June, and I have since obtained many other specimens at Weymouth. On each occasion the locality and circumstances were the same; rocky ledges, at extreme low water, spring-tide.

Fam. Actiniadæ.

Actinia miniata (mihi). The Scarlet Anemone.

Diameter to 1 inch when expanded. Disk broad, pale greenish gray, with radiating lines numerous and distinctly mottled with dark brown. Generally a conspicuous white band occupies one of the radiations. Tentacles numerous, in four rows, rather short, conical; pellucid brown, with indistinct annulations of pellucid dark brown and whitish; the base of each tentacle has two black and two bright white rings more or less distinct, alternating with each other. The outermost row of tentacles are peculiar; they consist of a sheath of pellucid brown hue, like the others, but each is permeated by a thick core of orange or vermilion, very brilliant, much resembling the central gland in the papilla of an *Eolis*. Sometimes the scarlet core is distinctly separate from the pellucid walls of the tentacle, at other times, *in the same individual,* it appears to fill the whole interior. In some specimens this phænomenon is partially or wholly wanting.

Contracted, it forms a button of about the same diameter, varying in degrees of depression or elongation, the base sometimes irregularly lobulate. Colour, a fine orange-scarlet, occasionally merging into purplish red towards the summit, studded with large pale glands, which become confluent and form pale radiating bands around the pursed mouth. Under a lens the scarlet colour is seen to run in slender veined lines.

Found adhering to oysters and pectens brought in by the trawlers: not uncommon. It may possibly be the immature state of *Act. parasitica.*

Act. clavata (Thompson), var. *rosea.* The Weymouth Anemone.

A very fine specimen when fully expanded has the disk $1\frac{1}{4}$ in. and the tentacles $\frac{1}{2}$ in. more on every side, making a diameter of $2\frac{1}{4}$ inches. It is so diaphanous as to be almost colourless, the disk showing clearly the convoluted filaments in the septal divisions. The tentacles are of a lovely rose-colour, studded with transversely-oval specks of white; they also are pellucid, and the hue is therefore much diluted; but when captured, they were deep purplish pink or crimson.

The exterior surface is rough, with multitudinous sucking glands, arranged in close-set perpendicular ridges of pale yellow warts, with a crimson freckled skin showing between. Every wart has a central crimson speck, and this seems constant; the

warts, and therefore the red specks, are exceedingly numerous; at the margin, where they are most distinct, they rise into rounded crenations.

This species was described by Mr. W. Thompson in the 'Zoologist' for 1851, and, as I believe, from a single specimen. The name *clavata* is objectionable, as the tentacles are not clubbed, though their tips are often curled up in a peculiar manner. I will not, however, commit the robbery of depriving the discoverer of his name, merely because I think I could find one more significant. It is quite common on the rocky ledges, inhabiting fissures and the deserted holes of boring Mollusca; but only at very low water level. There are two very distinct varieties; the ordinary state has been described by the discoverer; one more beautiful, but somewhat less common, I have sketched above.

Iluanthos Mitchellii. The Scarlet Free-Anemone.

Length about 2 inches, greatest diameter 1 inch. The form is stout, somewhat pear-shaped, thickening from the top for about $\frac{3}{4}$ inch, after which it gradually tapers to a blunt point at the base, in the centre of which is a minute wrinkled disk, which the animal does not appear to use as an adhesive sucker. The upper part of the body is pale scarlet, the lower two-thirds flesh-white, blotched with scarlet, the basal extremity scarlet.

The disk is very protrusile, not so wide as the body. In its centre is a prominent mouth with two thick lips of rich scarlet, toothed like that of a Caryophyllia. A ring of purplish black surrounds the lips, which is succeeded by a wider circle of white, and the remainder of the disk is pale red; the whole marked with the usual radiating ridges. The tentacles are about thirty-six, arranged in two complete rows; they are thick and rather short, conical, and usually curled; the bases of the two rows are in contact, but the outer is a full sixth of an inch from the margin, and the inner about as far from the base of the oral cone. They are pellucid white, marked on their inner sides with numerous alternate bands of opake-white and purple, sometimes taking a diagonal direction. The tentacle that is opposite the extremity of the linear mouth, on each side, is wholly dull purple, with pale bands almost obsolescent.

This very fine species was brought me by one of the Weymouth trawlers: I have named it after D. W. Mitchell, Esq., the able Secretary of the Zoological Society, in whose marine aquarium the specimen itself is deposited.

I shall hope to continue this series of notes, as fresh observations occur to me, and in the meanwhile remain,

Your obedient servant,

P. H. Gosse.

Weymouth, July 9th, 1853.

XV.—*On the Teeth of the Genus* Mitra, *Lamarck.*

By J. E. Gray, Ph.D., F.R.S., V.P.Z.S. &c.

The greater the number of examples of the different genera of Gasteropodous Mollusca I have been able to examine, the more I am convinced of the importance of the characters afforded by the teeth of these animals, both for arranging the species and genera into natural groups and characterizing them. The general results of my recent observations have been to verify the views I have from time to time published in this Journal on the subject. Within the last few days, however, I have been enabled to examine the teeth of six species of the genus *Mitra* of Lamarck, and with a very curious result. The teeth of each of the species are very different, and, what is still more extraordinary, they belong to three very different kinds: thus, *Mitra Grœnlandica* is the only one which has the single *rachiglossal* tooth of the *Volutidæ*, which is like that of the *Cymbiola Turneri* in form.

Mitra episcopalis, *M. adusta*, *M. Ticaonica*, and *M. cucumerina*, as belonging to the restricted genus *Mitra*, have three series of *odontoglossal* teeth like the family *Fasciolariadæ*. The broad lateral teeth, which were alone figured by Quoy and Gaimard as the teeth of the genus, are very uniform in shape and structure in the different species; while the central tooth of each offers considerable variation. In *Mitra adusta* it is narrow, and has only a single, very long, hook-like apex, while in the other species it is broader, with from five to eight teeth on its upper edge.

Lastly, *Mitra Caffra*, which belongs to Montfort's genus *Turris*, has the three series of *hamiglossal* teeth of *Muricidæ* and *Buccinidæ*.

This is another striking instance of the impossibility of arranging Gasteropodous Mollusca from the examination of the shell alone.

The genus *Mitra* was peculiar before for having some species with a distinct operculum, while the major part of them were without one. Unfortunately I have not yet been able to examine the teeth of an operculated species.

I may further observe, as connected with the family *Volutidæ*, that I have examined the proboscis of *Mitra* (*Cylindra*) *Dactylus* without being able to discover any teeth, but this may have arisen from the bad state of the specimen. The proboscis of this animal differs from the hard, smooth, rigid form of all the other species I have seen, in being of a spongy texture and closely covered with large conical warts externally.

Marginella (*quinqueplicata*) has a single *rachiglossal* series of

teeth like *Volutidæ*, which are broad, lunate, with nine small, conical, rather distant, transparent denticles on its front edge. *Voluta* (*Vespertilio*) has a single series of three-toothed teeth on the tongue like *Yetus* and *Cymbium*, but the central toothlet is much longer than the lateral ones.

BIBLIOGRAPHICAL NOTICES.

Système Silurien du Centre de la Bohême. 1ère partie, *Recherches Paléontologiques. Trilobites*, par J. Barrande. 2 vols. 4to.

The history of the palæozoic formations, both as regards the development of the organic life of the period and the physical conditions under which they were accumulated, appears almost to be more clearly revealed to us than that of the more recent accumulations of the later tertiary period. That a knowledge of the primæval fauna of our planet should be invested with peculiar interest to the zoo-geologist can scarcely be doubted, either in its relation to existing nature, or as pointing out to us the peculiar types of the earliest forms of animal existence. But few years have elapsed since a vast portion of the earlier fossiliferous rocks were classed under the names of greywacke and clay-slate, and were considered entirely destitute of organic forms. Traces of them were, however, discovered in the Scottish series by the acute geologist Hutton, and other observers, as Lhwyd, &c., had also noticed them in some localities. From the comparative rarity of the fossil organisms in the palæozoic formations known at that period, they could not have been used as a means of distinguishing the different members of the series, nor indeed was the attempt made so to classify them; for the great principle of characteristic fossils, subsequently enunciated by W. Smith, was applied chiefly to the secondary group of rocks. Little, however, was effected in the classification of these older greywacke rocks until the border counties of England and Wales and a portion of the Principality itself was made the special object of some years' study by Sir R. Murchison, who, "par ses conquêtes sur la nuit du temps," first initiated us with a knowledge of the earlier palæozoic epoch, comprising the Silurian system. From that period the active researches of geologists have demonstrated the existence of this group throughout large portions of the globe, characterized on the whole by similar forms of organic life, although, as would naturally be expected, modified in the subdivisions by local peculiarities. Since the publication of the 'Silurian System,' large and expensive works on the subject have been issued from the presses of America and Europe, and Siluria seems to be singularly fortunate in the zeal and liberality of her illustrators. Among the more remarkable and interesting is the magnificent volume by M. Barrande. A native of France, and formerly tutor to the Comte de Chambord, to whom the work is dedicated, M. Barrande has, from circumstances, resided for twenty years on the Silurian soil of Bohemia. Commencing his researches

in 1830 on the so-called "transition series," he was further stimulated in 1840 by the perusal of the 'Silurian System,' and his labours assumed a definite plan.

Those only who are conversant with the country, or will peruse the volume, can form any idea of the zeal and energy requisite for overcoming the difficulties of exploring this district, and the labour and great pecuniary outlay necessary for accumulating the treasures of this portion of the ancient Silurian fauna. Independently of his own explorations over the whole district with a view of finding the fossiliferous localities, whether in worked quarries, in ravines, or on the weathered surfaces of rocks, M. Barrande trained under his own eye and practically instructed a number of intelligent workmen (furnishing them with the necessary implements) for the more effectual carrying out his researches at different points, and who became so habituated to, and interested in, the employment, that scarcely the fragment of an organism was ever lost.

The following table will show the numerical result of species obtained during these researches :—

		Genera.	Species.
VERTEBRATA	Fishes	1	1
ARTICULATA	Trilobites	35	252
	Cytherinidæ	1	25 to 30
	Various	4	4
MOLLUSCA	Cephalopods	10	270 to 280
	Pteropods	2	25 to 30
	Gasteropods	?	140 to 150
	Brachiopods	?	180 to 200
	Acephala	?	140 to 150
	Bryozoa	3	22 to 25
RADIATA	Echinoderms	?	25 to 30
	Zoophytes	?	50 to 60

From the above it appears there are 1200 species of fossils from the Bohemian basin, averaging about eighty miles in length and thirty in width, a sufficient dish for any Silurian gourmand. The mere accumulation of such fossil treasures might be sufficient; but when the labour necessary for the determination of so many species is further considered, we must admire the industry of the author, and we are well aware of the conscientious care with which the whole has been effected. For (unlike some zoo-geologists, who centred in or satisfied with the narrow limits of their own knowledge and locality, not looking for determinations or comparisons elsewhere) M. Barrande has, with the true spirit of a scientific man, entered into correspondence with those naturalists who could assist him, and even visited many localities, this country in particular, with a view of personally comparing the Bohemian fossils with the published types, as well as with those not yet figured*. The present volume, with the

* Particularly the collection of the Geological Survey, with the kind co-operation of Prof. E. Forbes, and the important assistance of Mr. J. W. Salter's practical knowledge, who has made the palæozoic fauna his especial study.

atlas, (containing the Trilobites,) is only the first portion of the work, which will be followed by two more (containing the Cephalopods, &c.), forming a complete history of the Silurian system of Bohemia. The text, consisting of more than 900 pages, is devoted (with the exception of the historical introduction and geological sketch) to details connected with the determination of the family of Trilobites, and is illustrated by nearly 2000 carefully engraved figures of all the forms and varieties assumed by the different species.

The *Historical introduction* gives a chronological list of all the authors who have contributed to the knowledge of the palæozoic formation of the centre of Bohemia, with an analysis of their respective merits and the points of special interest furnished by each writer.

The *Geological sketch*, which is merely preliminary to a more detailed one to be given in the third volume, is inserted for the purpose of enabling the reader to understand the position of the stratum indicated for each species.

The Silurian rocks of Bohemia are divided by M. Barrande into an upper and lower system, of four stages each, reposing on one another, and having a conformable stratification, the lower group, A–D, being chiefly siliceous and argillaceous, the upper, E–H, mostly calcareous, and reposing on a trappean base and schists with Graptolites.

Upper Division.

H. Argillaceous schists, containing but few fossils.

G. Argillaceous limestone, with 10 genera and 40 species of Trilobites, 10 Brachiopoda, 6 genera and 10 species of Cephalopods.

F. Mostly calcareous; 10 genera and 75 species of Trilobites, 8 genera and 109 species of Brachiopoda, 6 genera and 26 species of Cephalopods.

E. Trappean and schistose rocks; 17 genera and 78 species of Trilobites; 22 genera and 220 species of Cephalopods; 65 species of Brachiopods.

Lower Division.

D. Quartzites and schistose rocks; 23 genera and 61 species of Trilobites; also Cephalopods, Brachiopods, &c.

C. Protozoic schists, argillaceous schists, with 7 genera and 25 species of Trilobites; other forms very rare.

A, B. Azoic series, chiefly crystalline and argillaceous schists and conglomerates.

The divisions C to H are distinguished from one another, (1) by a marked predominance of families or different classes in each of the superposed stages; (2) in having a very small number of species common to two or more stages.

The palæontological contrast consists principally in the occurrence of certain genera exclusively characteristic of the lower division C, D, as *Paradoxides, Conocephalus, Ellipsocephalus, Sao, Agnostus, Asaphus*, &c.; also in the development of certain other types, as *Illænus* and *Ampyx*, which scarcely pass the limits of this division.

The upper division, E–H, presents other genera which in Bohemia

do not occur in the lower, as *Harpes*, *Bronteus*, *Proëtus*, *Deiphon*, *Phragmoceras*, *Ascoceras*, *Trochoceras*, and *Cardiola*, &c. We may remark, however, that in the genera common to the two divisions, the species present considerable modification of form. Thus, in *Acidaspis*, the species belonging to the lower division have ten or more thoracic segments, while those of the upper possess only nine. Other specific modifications are presented in the genera *Cheirurus* and *Ampyx*, which are also found in both divisions.

Decided as is the line of demarcation between the two great divisions, by the outburst and spreading over of a vast mass of trappean matter at the termination of the lower division, yet a curious fact is recorded by M. Barrande, in the local appearance or colony of fifty-seven species belonging to the third fauna E, within the limits of the second or lower fauna D. This colony of species, limited in extent, appears therefore to have survived, either by migration or otherwise, the causes which effected the extinction of the whole lower fauna with which it is intercalated.

Of the three successive Silurian faunas, defined by the distribution of the genera of Trilobites, the lower or primordial one C, contains only one genus, *Agnostus*, which passes into the second, and that under different specific forms. This group corresponds to the Olenus schists of the Malverns, and the Lingula beds of Merionethshire, &c. In England, according to Mr. Salter, "*Agnostus* is generally characteristic, not of the first, but of the second zone or true Llandeilo flags." In the second fauna D, the *genera* of Trilobites have attained their maximum development; some are peculiar to it, others have reached their numerical specific maximum, and a third set have their greatest development in the superior fauna. Associated with these are numerous Cephalopods, Brachiopods, Pteropods and Acephala, which have a very unequal geographical distribution. This group appears to be the equivalent of the Llandeilo and Bala beds of N. Wales.

These two faunas may be regarded as only subsections of the lower division, and this appears to be the opinion of Mr. Salter, who, from an examination of the British localities, states, "It may perhaps be necessary hereafter to modify the conclusions drawn by so able and successful an observer as M. Barrande, as to the primordial and isolated character of his earliest fossil group; it may be a local, and not a general phænomenon." The third fauna E–H, forming the upper division and equivalent to the Upper Silurian, contains many genera of the second fauna, but the assemblage of the specific forms and their characters are very different. Here, however, the *species* of Trilobites, and not the genera, attain their maximum.

The upper limits of this fauna, or its relation to the Devonian, are perhaps not distinctly defined, although M. Barrande states that Silurian Trilobitic types range throughout, accompanied by Brachiopoda, Gasteropoda, &c. In a previous memoir on the Brachiopoda, by M. Barrande, we thought we had recognized many forms very analogous to, if not identical with, Devonian species of other districts; this, however, is a subject for further inquiry.

Although a unity may pervade the Silurian system as a whole, yet that the members comprising it may present a diversity is fully shown by comparing the local faunas, in their relation to the epoch at which each class has attained its development, in different countries. Thus, "The Cephalopods have flourished in the Silurian seas of N. America, Russia and Sweden, during the deposition of the lower division, scarcely a trace of them being found in the equivalent strata of England and Bohemia; these mollusks, however, abound in the upper division of these latter countries, becoming rare at the same epoch in Russia and N. America. England and Bohemia present another contrast in the Brachiopoda. In the former country this class attained its maximum towards the *base* of the upper division or Wenlock stage, while the Cephalopods abounded in the superior Ludlow beds. The reverse has happened in Bohemia, where the maximum of the Cephalopods is found in group E, and that of the Brachiopods at a higher level in group F." In comparing, however, the geognostical and palæontological characters, there is a general resemblance between the two great divisions of the Silurian strata of Bohemia and those of the typical district of England, France, Sweden, Russia, and N. America.

The *Palæontological portion*, which forms the chief part of the volume, is full of most curious and instructive data, and is divided into two parts, the first comprising the special study of the different parts and elements of Trilobites, with an essay on their classification; the second contains a detailed description of the genera and species found in Bohemia.

The first portion is treated in a series of sections, of which the following are the most important:—The form and principal parts of the body of Trilobites (illustrated in plate 1);—the elements composing the head (pls. 2 & 3), as the glabella, the sutures, the eyes (pl. 3), their form and proportion, the cheeks or lateral lobes, the hypostome and epistome;—the elements of the thorax, as the form of the thoracic segments and their articulation, the two types of the pleura (illustrated in pls. 4–6), the number of segments, the power of coiling up, and the value of the characters furnished by it;—the elements of the pygidium, its form, axis, lateral lobes, and contour;—nature and ornaments of the shell of Trilobites;—metamorphosis and mode of existence of Trilobites;—the distribution of them, both as regards their vertical and horizontal diffusion, and which is graphically illustrated in pls. 50 & 51.

Among the protean forms of Trilobites, the *Sao hirsuta* appears the most remarkable. First described in 1846, its numerous synonyms would lead us to infer that it had passed through all the vacillations of an older palæontological nomenclature, for it rejoices in more names than would gladden the heart of a Spanish Hidalgo. It has been assigned to no less than twelve genera and twenty-two species; but the minute researches of M. Barrande have clearly proved that between the embryonic state, which is simply a flattened disk with a body axis, and the head and thorax not distinct, to the adult form with nineteen articulations, this Trilobite has passed through eighteen

different degrees of development, to each of which a distinct name has been given.

Without proceeding with further details on the many interesting points treated of, we may cordially recommend this work to the student of palæozoic geology, not only as illustrating a chapter of its history, but from the fact that the Trilobites play an important part in the Silurian fauna. The naturalist also, interested in the study of the Articulata, will here observe the frequent anomalies that are found in the arrangement of the elements of the bodies of these ancient crustaceans, compared to the regularity of the law recognized among the modern forms,—presenting an important suggestive subject, and which must not be forgotten in the great question regarding the successive development of this group of animals. We may therefore hope that the zoological interest, which has long existed respecting the Trilobites, will be still further excited by the great variety of new facts observed in the Bohemian species.

Popular Physical Geology. By J. B. Jukes, F.R.S. 12mo. Reeve and Co., London, 1853.

This volume forms part of a series of useful works on Natural Science, and is intended to convey, in a popular manner, the general principles of physical geology. The author, who is well acquainted with practical field geology, does not pretend to have given much original matter, in the sense of new facts, the object being to describe the common facts and principles of geology, in a clear and concise manner, without entering too much into the detail of the observations by which those facts have been discovered, or on which those principles have been established. In this respect he has somewhat succeeded, treating the subject with a freshness and spirit, and showing that "geology is not a mere dull and barren disquisition on the nature and composition of rocks and stones, but has become incidentally, as it were, the opening to a full, rich, and varied history of the earth, embodying the labours of the naturalist, the chemist, and the physicist,—of all who study the living beings that people it, the constitution of the matter that composes it, or the laws of force that act upon it—into one great harmonious whole." The first part of the work contains the elementary facts and principles, and is followed by a general sketch of the series of stratified rocks. The subject of the formation of sand, gravel, clay, &c., is clearly and concisely treated, and it is well observed, that he who thoroughly understands the origin and nature of common sand, has made no despicable commencement in the study of the science. We could have forgiven the author, had he ventured a little more into the domain of palæontology, when treating of the stratified rocks, for it has become so essential a part of geology, that some acquaintance with it is necessary, just as a knowledge of chemistry and mineralogy are equally useful to the student of the crystalline and volcanic rocks. The accompanying plates are artistic, and illustrative of some principal features in physical geology.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

May 13, 1853.—The Duke of Northumberland, K.G., F.R.S., President, in the Chair.

On some New Points in British Geology. By Prof. Edward Forbes, F.R.S., President of the Geological Society.

Not many years ago it used to be said, that the geology of England was done, and yet the best investigated localities are constantly affording fresh discoveries. When the Lecturer last year exhibited Captain Ibbetson's beautiful and accurate model of Whitecliff Bay in the Isle of Wight, in illustration of his views respecting the distribution of species in time, he had not the slightest suspicion that this particular locality, so often and apparently so thoroughly explored, could yield new results and new interpretations. Nevertheless, having had occasion, at the suggestion of Sir Henry De la Beche, to examine the tertiary strata of the Isle of Wight for the purposes of the Geological Survey of Great Britain, this very bay of Whitecliff proved to be a rich source of novel geological information. Moreover, a great portion of the Isle of Wight, on further examination, turned out to belong to a division of the older tertiaries, that had never been demonstrated to exist within the British Islands. As a general statement of these results and of their bearings may be more intelligible to non-professional lovers of geology than the detailed memoirs about to be published on the subject, Professor Forbes has taken this opportunity of communicating them to the Members of the Royal Institution.

The Isle of Wight is divided into two portions by a great chalk ridge running east and west. This is the ridge of vertical chalk beds. To the north of it, the country is composed of tertiary, to the south, of older strata, as far down in the geological scale as the Wealden. The Lower Greensand or Neocomian beds occupy the greater part of the surface of the southern division, and freshwater tertiaries that of the northern. At Alum Bay, on the west, and Whitecliff Bay, on the east, the ends of the older tertiary strata, as they rise above the chalk, are seen truncated and upturned, being all affected by the movement which caused the verticality of the chalk. These tertiaries constitute the following groups, successively enumerated in ascending order: the Plastic clay, the Bognor series (equivalents of the true London clay), the Bracklesham series, and the Barton series, upon which lie the Headon Hill sands, and those freshwater strata that spreading out form the gently undulating country, extending from near the base of the chalk ridge to the sea.

Owing to the sections at Headon Hill near Alum Bay being so clear and conspicuous, and their position being in the loftiest tertiary hill that exhibits its internal structure in the island, the freshwater and fluvio-marine beds which compose that elevation have long attracted attention and have been described by many observers,

the first of whom was the late Professor Webster. The apparent slight inclination of these beds, as seen in the Headon section, except at the point where they are suddenly curved in conformity with the verticality of the chalk and the beds immediately above it, appear to have led geologists to the notion that the fluvio-marine portion of the Isle of Wight was composed entirely of continuations of the beds forming Headon Hill. Two observers only suspected a discrepancy, viz. Mr. Prestwich, who, in a short communication to the British Association at Southampton, expressed his belief that Hempstead Hill, near Yarmouth, would prove to be composed of strata higher than those of Headon; and the Marchioness of Hastings, who, having given much time to the search for the remains of fossil vertebrata in the tertiaries of the Isle of Wight and Hordwell, declared her conviction that these remains belonged to distinct species, according as they were collected at Hordwell, Hempstead, and Ryde, and that these three localities could not, as was usually understood, belong to the same set of strata. The recently published monograph of the pulmoniferous mollusks of the English Eocene Tertiaries, by Mr. Frederic Edwards, afforded also indications of the shells therein so well described and figured having been collected in strata of more than one age.

A few days' labour at the west end of the island convinced Professor Forbes that the surmises alluded to were likely to prove true, and that the structure of the north end of the island had been in the main misunderstood. After four months' constant work at both extremities and along the intermediate country, he succeeded in making out the true succession of beds, with most novel and gratifying results. During this work he was greatly aided by his colleague, Mr. Bristow, and by Mr. Gibbs, an indefatigable and able collector attached to the Geological Survey.

The freshwater strata of Whitecliff Bay proved to be wholly misinterpreted. Instead of their being constituted out of the Headon Hill strata only, more than a hundred feet thickness of them are additional beds characterized by peculiar fossils, and resting upon a marine stratum that overlies the Bembridge limestone, the equivalent of which at Headon is a soft concretionary calcareous marl, scarcely visible except in holes among the grass immediately under the gravel on the summit of the hill.

The beds of the true Headon series, in fact, are all included in the subvertical portion of the Whitecliff sections and are there present in their full thickness. They are succeeded by peculiar strata of intermediate character, for which the name of St. Helen's beds is proposed, and which become so important near Ryde that they constitute a valuable building stone. The Bembridge limestone that lies above is the same with the Binstead limestone near Ryde, out of which were procured the remains of quadrupeds of the genera *Anoplotherium*, *Palæotherium*, &c., identical with those found in the gypsiferous beds of Montmartre. The Sconce limestone near Yarmouth is also the same, and none of these limestones are identical with any of those conspicuous among the fluvio-marine strata at

Headon Hill, and with which they have hitherto been confounded. They are far above them, and are distinguished by distinct and peculiar fossils.

Almost all the country north of the chalk ridge, exclusive of the small strip occupied by the marine Eocenes, is composed of marls higher in the series than any of the Headon Hill beds, and hitherto wholly undistinguished, except in the Whitecliff section, where the age and relative position had been entirely mistaken. These are the Bembridge marls of Professor Forbes. Above them are still higher beds preserved only in two localities, viz. at Hempstead Hill, to the west of Yarmouth, and in the high ground at Parkhurst. For these the name of Hempstead series is proposed. Their characteristic fossils are very distinct, and the highest bed of the series is marine. These beds prove to be identical with the Limburg or Tongrien beds of Belgium and with the Grès de Fontainebleau series in France. We thus get a definite horizon for comparison with the Continent, and are enabled to show, that instead of our English series of Eocene tertiaries being incomplete in its upper stages as compared with those of France and Belgium, it is really the most complete section in Europe, probably in the world. We are enabled by it to correct the nomenclature used on the Continent, and to prove that the so-called Lower Miocene formations of France and Germany are in true sequence with the Eocene strata, and are linked with them both stratigraphically and by their organic contents. We are also enabled to refer, with great probability, the so-called Miocene tertiaries of the Mediterranean basin, of Spain and Portugal,—those of the well-known Maltese type—to their true position in the series, and to place them on a horizon with the Tongrien division of the Eocenes. As these Maltese beds are unconformable, and evidently long subsequent to the deposition of the great nummulitic formation, we are enabled to assign an approximate limit to the estimate of the latest age of that important series. From well-marked analogies we get at a probable date even for the Australian tertiaries. Thus the deciphering of the true structure of a small portion of the British Islands can throw fresh light upon the conformation of vast and far-apart regions.

The peculiar undulatory contour of the surface of the fluvio-marine portion of the Isle of Wight is due to the gentle rolling of these beds in two directions, one parallel with the strata of the chalk ridge, and the other at right angles to it. The valleys and hills running northwards to the sea depend upon the synclinal and anticlinal curves of the latter system of rolls, a fact hitherto unnoticed, and the non-recognition of which has probably been one cause of the erroneous interpretation of the structure of the Isle of Wight, hitherto received. The truncations of these curves along the coast of the Solent exhibit at intervals beautiful and much neglected sections, well worthy of careful study. There is one of these sections near Osborne. Her Majesty's residence stands upon a geological formation hitherto unrecognized in Britain. Near West Cowes there are several fine sections along the shore. The total

thickness of unclassified strata in the Isle of Wight is 400 feet, if not more, and within this range are at least two distinct sets of organic remains. The fluvio-marine beds in all, including the Headon series, are very nearly 600 feet thick.

ZOOLOGICAL SOCIETY.

May 27, 1851.—W. Yarrell, Esq., V.P.L.S., in the Chair.

Description of new Land Shells from the Collection of H. Cuming, Esq. By Dr. L. Pfeiffer.

1. Helix audebardi, Pfr. *H. testâ imperforatâ, conoideo-globosâ, solidulâ, nitidâ, castaneo-fulvâ, strigis saturatioribus confertis ornatâ; spirâ conoideâ, apice obtusiusculâ, albidâ; anfractibus 5½ convexis, summis granulatis, ultimis irregulariter rugoso-striatis, ultimo inflato, anticè deflexo; columellâ perdeclivi, subarcuatâ, latâ, planâ, albâ; aperturâ perobliquâ, truncato-ovali, intus cæruleâ, nitidâ; peristomate incrassato, subreflexo, albo.*
Diam. maj. 48, min. 39, alt. 35 mill.
Hab. St. Domingo (*Sallé*).

2. Helix albersiana, Pfr. *H. testâ umbilicatâ, subturbinato-depressâ, tenui, acutè et confertim costatâ, diaphanâ, rufo-corneâ; spirâ subturbinatâ, apice acutâ; anfractibus 4½ convexis, celeriter accrescentibus, ultimo anticè deflexo, basi juxta umbilicum angustè constricto; aperturâ perobliquâ, lunato-ovali; peristomate tenui, marginibus subconniventibus, dextro breviter expanso, columellari dilatato, reflexo, intus plicâ obliquâ, dentiformi munito.*
Diam. maj. 14½, min. 12, alt. 8½ mill.
Hab. St. Domingo (*Sallé*).

3. Helix pubescens, Pfr. *H. testâ angustissimè umbilicatâ, depressâ, tenui, pilis mollibus, brevibus, confertis pubescente, diaphanâ, lutescente; spirâ vix convexâ, obtusâ; anfractibus 5, convexiusculis, ultimo subrotundato, altiore quam lato, non descendente; aperturâ vix obliquâ, rotundato-lunari; peristomate simplice, recto, margine columellari supernè breviter reflexo.*
Diam. maj. 11, min. 10, alt. 6 mill.
Hab. St. Domingo (*Sallé*).

4. Helix leucorhaphe, Pfr. *H. testâ angustè umbilicatâ, depresso-turbinatâ, subtilissimè striatulâ, diaphanâ, luteo-corneâ, fasciâ angustâ, cretaceâ, ad suturam ornatâ; spirâ subturbinatâ, apice obtusiusculâ; anfractibus 6 planiusculis, ultimo convexiore, non descendente, basi subplanato; aperturâ vix obliquâ, lunari; peristomate simplice, recto, margine columellari reflexiusculo.*
Diam. maj. 10, min. 9, alt. 6 mill.
Hab. St. Domingo (*Sallé*).

5. Succinea dominicensis, Pfr. *S. testâ ovali, solidulâ, substriatâ, corneo-albidâ, punctis corneis irregulariter aspersâ; spirâ conicâ, acutâ; anfractibus 3½ convexis, summis corneis, ultimo*

$\frac{3}{5}$ longitudinis æquante; columellâ subcallosâ, vix recedente; aperturâ parùm obliquâ, ovali, subregulari, supernè vix angulatâ.

Long. 11$\frac{1}{2}$, diam. 7, alt. fere 6 mill. Apert. 7$\frac{1}{2}$ mill. longa, medio 4$\frac{1}{2}$ lata.

Hab. St. Domingo (*Sallé*).

6. Bulimus moussoni, Pfr. *B. testâ perforatâ, oblongo-conicâ, sublævigatâ (lineis impressis spiralibus obsoletis notatâ), nitidulâ, albâ, fasciis sub 5, roseis ornatâ; spirâ conicâ, apice acutâ, rubrâ; anfractibus 6, subplanis, ultimo spirâ paulò breviore; columellâ arcuatâ, supernè subtortâ; aperturâ oblongo-ovali, intus concolore; peristomate simplice, recto, margine columellari fornicatim reflexo.*

Long. 26, diam. 12 mill. Apert. 12 mill. longa, 7 lata.

Hab. St. Domingo (*Sallé*).

Next allied to *B. Hondurasanus*, Pfr.

7. Achatina dunkeri, Pfr. *A. testâ turritâ, tenuiusculâ, lævigatâ, pellucidâ, nitidâ, fulvescente; spirâ elongatâ, apice obtusâ; suturâ impressâ, marginatâ, obsoletè crenulatâ; anfractibus 9, vix convexiusculis, ultimo $\frac{1}{3}$ longitudinis non attingente; columellâ arcuatâ, altè et subverticaliter truncatâ; aperturâ subtriangulari-semiovali; peristomate simplice, margine dextro antrorsum arcuato.*

Long. 28, diam. 7$\frac{1}{2}$ mill. Apert. 9 mill. longa, medio 4 lata.

Hab. St. Domingo (*Sallé*).

8. Achatina impressa, Pfr. *A. testâ oblongo-turritâ, tenui, lævigatâ, lineis impressis longitudinalibus irregulariter notatâ, fulvidâ; spirâ turritâ, apice acutiusculâ; suturâ impressâ, submarginatâ; anfractibus 6$\frac{1}{2}$ planis, ultimo $\frac{2}{5}$ longitudinis subæquante; columellâ arcuatâ, basi abruptè truncatâ; aperturâ obliquâ, sinuato-ovali; peristomate simplice, margine dextro basi recedente.*

Long. 8$\frac{1}{2}$, diam. 2$\frac{2}{3}$ mill. Apert. 3 mill. longa, medio 1$\frac{1}{2}$ lata.

Hab. St. Domingo (*Sallé*).

9. Balea dominicensis, Pfr. *B. testâ subperforatâ, sinistrorsâ, turritâ, sublævigatâ, nitidâ, olivaceo-corneâ; spirâ regulariter attenuatâ, apice acutâ; anfractibus 12, convexis, ultimo infra medium subangulato; aperturâ verticali, subovali; peristomate simplice, recto, margine columellari verticali, breviter reflexo.*

Long. 11$\frac{1}{2}$, diam. 3 mill. Apert. 2$\frac{1}{2}$ mill. longa, 1$\frac{3}{4}$ lata. (An adult.?)

Hab. St. Domingo (*Sallé*).

10. Cylindrella monilifera, Pfr. *C. testâ subrimatâ, oblongâ, solidulâ, truncatâ, confertissimè et arcuatim costulato-striatâ; opacâ, sordidè albidâ; suturâ impressâ, nodulis albidis subdistantibus notatâ; anfractibus (superst.) 9, convexis, ultimo non soluto, basi subacutè carinato; aperturâ obliquè subcirculari, ad carinam canaliculatâ; peristomate albo, reflexiusculo-expanso, supernè appresso.*

Long. 19, diam. supra medium 6 mill. Apert. cum peristomate oblique 5 mill. longa, 4$\frac{1}{2}$ lata.

Hab. St. Domingo (*Sallé*).

11. Cylindrella adamsiana, Pfr. *C. testâ vix rimatâ, oblongo-pupiformi, truncatâ, nitidâ, confertè striato-punctatâ, albidâ, corneâ, irregulariter strigatâ et variegatâ; suturâ lineari, albo-crenulatâ; anfractibus* (*superst.*) 8–9, *planis, ultimo angustiore, non soluto, basi cristâ compressâ, obtusâ munito; aperturâ vix obliquâ, subcirculari, ad cristam subcanaliculatâ; peristomate albo, breviter expanso-reflexo, supernè interrupto.*
Long. 14–15½, diam. 5 mill. Apert. 4¼ mill. longa et lata.
Hab. St. Domingo (*Sallé*).

12. Cylindrella salleana, Pfr. *C. testâ non rimatâ, cylindraceâ, gracili, truncatâ, obliquè confertissimè costulato-striatâ, nitidâ, pallide fuscescente, vel rufo-fuscâ; anfractibus* (*superst.*) 17–18, *vix convexiusculis, ultimo angustiore, basi carinâ compressâ, acutâ munito, antrorsum breviter porrecto; aperturâ subobliquâ, rhombeo-rotundatâ, ad carinam distinctè canaliculatâ; peristomate albo, nitido, undique reflexiusculo-expanso.*
Long. 27, diam. (prope basin) 5 mill. Apert. cum peristomate 4⅔ mill. longa et lata.
Hab. St. Domingo (*Sallé*).

13. Cylindrella gouldiana, Pfr. *C. testâ vix subrimatâ, turritâ, truncatâ, confertissimè costulato-striatâ, sericeâ, pallide corneâ; suturâ impressâ, subdenticulatâ; anfractibus* (*superst.*) 9, *convexiusculis, ultimo soluto, antrorsum breviter descendente, basi subcompresso; aperturâ subobliquâ, ferè circulari, latere dextro subangulatâ; peristomate albo, undique breviter expanso.*
Long. 10, diam. 2⅓ mill. Apert. 2 mill. longa et lata.
Hab. St. Domingo (*Sallé*).

14. Cyclostoma orbignyi, Pfr. *C. testâ subperforatâ, elongato-pupoideâ, solidâ, confertim arcuato-striatâ, rubello-fulvâ; spirâ subcylindricâ, sensim attenuatâ, apice conicâ; suturâ profundâ; anfractibus* 8 *vix convexis, penultimo lato, ultimo fasciâ latâ violaceâ, antrorsum evanescente, ornato, basi cristâ compressâ, obtusâ munito; aperturâ circulari; peristomate incrassato, subreflexo, supernè appresso, infra cristam anfractibus penult. subexciso. Operculum tenue, albidum, extus concavum, arctispirum.*
Long. 27, diam. 9 mill.
β. Unicolor virenti-fulvum.
γ. Minus, interdum omnino violaceum, anfractibus convexioribus.
Hab. St. Domingo (*Sallé*).

15. Helicina versicolor, Pfr. *H. testâ depressâ, tenui, lævigatâ, citrinâ, sæpe viridi variegatâ, suturâ vel vertice purpureo; spirâ parùm elevatâ, obsoletè papillatâ; anfractibus* 4½, *planiusculis, rapidè accrescentibus, ultimo lato, subdepresso, anticè vix descendente; aperturâ diagonali, subtriangulari-semiovali; columellâ brevissimâ, callum crassum, semicircularem, nitidum, album emittente; peristomate breviter expanso, margine basali subreflexo, immediatè in columellam continuato. Operculum tenue, submembranaceum, castaneum, margine columellari et nucleo pallidis.*
Diam. maj. 8, min. 6⅔, alt. 5½ mill.
Hab. St. Domingo (*Sallé*).

16. Helicina dominicensis, Pfr. *H. testâ globoso-conicâ, solidulâ, concentricè confertim striatâ, parùm nitidâ, albidâ, luteo-vel fulvo-zonatâ; spirâ conicâ, acutâ; anfractibus 6, planiusculis, suturâ profundâ junctis, ultimo convexiore, vix descendente; columellâ brevissimâ, basi denticulatâ, callum emittente tenuem, vix circumscriptum; aperturâ parùm obliquâ, semiovali; peristomate acuto, subrecto. Operculum tenue, testaceum, carneum, margine columellari elevato.*

Diam. maj. $6\frac{1}{3}$, min. $5\frac{3}{4}$, alt. 5 mill.

Hab. St. Domingo (*Sallé*).

Descriptions of new Species of Trochidæ. By Arthur Adams, R.N., F.L.S. etc.

Genus Trochus, Linn.—*Pyramidea*, sp. Swains.

1. Trochus Cumingii, A. Adams. *T. testâ turrito-conicâ, violaceâ, maculis viridibus pulcherrimè pictâ; anfractibus planis, cingulis granorum moniliformibus ornatis, infernè nodoso-plicatis, anfractu ultimo angulato, peripheriâ radiatim nodo-spinosâ, basi concavâ, cingulis granulosis, insculptâ, centro profundè excavato umbilicum simulante; columellâ supernè tortuosâ, basi dente terminatâ; aperturâ tetragonâ; labro intus lirato.*

Hab. Sibonga, island of Zebu, under stones at low water (*H. C.*). Mus. Cuming.

2. Trochus fastigiatus, A. Adams. *T. testâ conicâ, imperforatâ, rubrâ, maculis albis longitudinalibus variegatâ; anfractibus planis, in medio concavis, supernè cingulis tribus nodulorum ornatis, ad suturam nodis subspinosis instructis, basi planâ, concentricè liratâ; liris crenulatis; columellâ posticè canaliculatâ, anticè truncatâ; labro in medio angulato.*

Hab. ——?

Genus Pyramis, Chemn.

Tectus, Montf.—*Pyramidea*, sp. Swains.

1. Pyramis architectonicus, A. Adams. *P. testâ conicâ, imperforatâ, albidâ; anfractibus planis, subimbricatis, longitudinaliter costatis, costis crassis, rotundis, subnodosis, basi planâ, liris concentricis exaratâ; columellâ brevi, tortuosâ, anticè truncatâ; labro margine fimbriato.*

Hab. Signet Bay, North Australia (*Dring*).

2. Pyramis leucogaster, A. Adams. *P. testâ conicâ, imperforatâ; spirâ acutâ, in medio tumidâ, albâ, viridi variegatâ; anfractibus planulatis, longitudinaliter corrugatis, transversim cingulis nodulosis ornatis, ad suturam nodis sulcatis fimbriatis, basi planâ, albâ, concentricè sulcatâ; columellâ brevi, valde tortuosâ; labro anticè intus lirato.*

Hab. ——?

Genus INFUNDIBULUM, Montf.—*Carinidea*, Swains.

1. INFUNDIBULUM CHLOROMPHALUS, A. Adams. *I. testâ depresso-conicâ, pseudo-umbilicatâ, viridi, atro-purpureo punctatâ; anfractibus planis, cingulis confertis granorum ornatâ, basi concavâ, cingulis inæqualibus articulatis insculptâ, regione umbilicali infundibuliformi, intus viridi; columellâ supernè tortuosâ, tuberculatâ.*

Hab. ——?

2. INFUNDIBULUM CALIFORNICUM, A. Adams. *I. testâ depresso-conicâ, pseudo-umbilicatâ, albidâ, viridi rufoque variegatâ; anfractibus planis, supra angulatis, ultimo angulato, cingulis tuberculorum subdistantium multiformium ornatâ; interstitiis longitudinaliter obliquè costatis, basi concavâ, cingulis confertis crenulatis insculptâ, regione umbilicali infundibuliformi, viridi, lineâ albâ elevatâ cinctâ; columellâ supernè tortuosâ, tuberculatâ.*

Hab. California.

Genus POLYDONTA, Schumacher.—*Lamprostoma*, Swains.

1. POLYDONTA GIBBERULA, A. Adams. *P. testâ elevato-conicâ, in medio gibbosâ, anfractu ultimo angustato; albidâ, lineis roseis flammulatis radiatim pictâ; anfractibus subconvexis, cingulis granosis transversis ornatâ, ultimo obtusè angulato; basi convexiusculâ, albâ, fasciis roseis radiatim pictâ; centro excavato, umbilicum mentiente; columellâ supernè solutâ, margine tuberculo-denticulato; labro intus lirato, infernè denticulato.*

Hab. Philippines.

2. POLYDONTA PALLIDULA, A. Adams. *P. testâ elevato-conicâ, albidâ, maculis luteolis pictâ; anfractibus planis, cingulis tuberculorum ornatâ, tuberculis infernè in costas excurrentibus, basi convexâ, cingulis granosis ornatâ, cavitate contortâ umbilicum simulante; columellâ supernè solutâ, margine tuberculato-dentato; labro intus lirato, infernè denticulato.*

Hab. ——?

3. POLYDONTA CORRUGATA, A. Adams. *P. testâ elevato-conicâ, albidâ, rufo-fusco variegatâ; anfractibus planiusculis, sulcis transversis, sulcisque obliquis nodoso-reticulatis, infernè obliquè costatis, costis nodosis ornatis; basi planiusculâ, in medio concavâ, excavatâ, umbilicum mentiente; columellâ supernè solutâ, margine tuberculato-dentato; labro intus lirato, infernè denticulato.*

Hab. ——?

4. POLYDONTA SQUAMIGERA, A. Adams. *P. testâ elato-conicâ, albidâ, cinereo-viridi radiatim pictâ; anfractibus planiusculis, cingulis granulorum tribus ornatis, infernè obliquè costatis, costis in spinis squamiformibus excurrentibus, basi planâ striis granosis, fasciisque rufo-viridibus ornatâ, centro excavato umbilicum simulante, intus albo lineis elevatis cincto; aperturâ lineis acutis elevatis, transversis in faucibus instructâ.*

Hab. ——?

Genus Phorcus, Risso.—*Omphalius*, Philippi.

1. Phorcus nodicinctus, A. Adams. *P. testâ conoideâ, umbilicatâ, fuscâ luteo variegatâ, lævi; anfractibus subplanulatis, cingulis tribus nodulosis, liris elevatis transversis ornatis, anfractu ultimo subangulato, basi convexiusculâ, lineis elevatis concentricis sculptâ, regione umbilicali albidâ; columellâ brevi, arcuatâ, basi dentibus duobus terminatâ; labro fusco marginato.*
Hab. ——?

2. Phorcus granifer, A. Adams. *P. testâ orbiculato-conicâ, fuscâ, cingulis transversis granorum distantium ornatâ, cingulis remotiusculis, interstitiis transversim liratis; anfractibus rotundatis, suturâ canaliculatâ; umbilico aperto, perspectivo; columellâ sinuatâ, basi dentibus duobus terminatâ; labro intus crenulato.*
Hab. ——?

3. Phorcus liratus, A. Adams. *P. testâ conoideâ, umbilicatâ, fuscâ, lineis pallidis undulatis ornatâ, cingulis distantioribus transversis insculptâ; columellâ sinuatâ, basi dentibus tribus terminatâ, umbilico aperto, perspectivo, peromphalo viridulo; labro intus lævi.*
Hab. ——?

4. Phorcus semigranosus, A. Adams. *P. testâ orbiculato-conoideâ, umbilicatâ, purpureo alboque variegatâ, transversim tenuiter striatâ; anfractibus planiusculis, cingulis confertis subgranosis ornatis, ultimo subangulato, basi planiusculâ, cingulis granosis insculpto; margine umbilici lineâ albâ elevatâ cincto; labio supra calloso; columellâ supernè sinuatâ, basi in tuberculis duobus terminatâ et infra tuberculos dentibus duobus instructâ; labro intus lævi, anticè callo marginato.*
Hab. West Indies.

5. Phorcus californicus, A. Adams. *P. testâ orbiculato-conicâ, profundè umbilicatâ, viridi, atro-purpureo radiatim maculatâ, liris transversis subnodulosis inæqualibus ornatâ; anfractu ultimo subangulato; basi convexiusculâ; umbilico perspectivo; labio in medio valde excavato, columellâ anticè dentatâ, intus lævi.*
Hab. California. Mus. Cuming.

Genus Clanculus, Montfort.

Polydonta b., Schum.—*Fragella*, Swainson.—*Apiculum*, sp., Humph.—*Monodonta*, sp., Lamk.—*Otavia*, Risso (not Cantraine).

1. Clanculus ormophorus, A. Adams. *C. testâ depresso-conicâ, umbilicatâ; anfractibus rotundatis, cingulis granorum æqualibus ornatis, cingulo primo, secundo et tertio granis fuscis albis alternantibus, quarto granis fuscis ornatis; anfractu penultimo gibboso, ultimo rotundato; umbilico crenulato; columellâ callosâ, subreflexâ, basi dente triplicato.*
Hab. ——?

2. Clanculus variegatus, A. Adams. *C. testâ depresso-conicâ, pallidâ, rufo-fusco variegatâ; anfractibus supra tumidis, cingulis granorum ornatis; interstitiis striis obliquis longitudinalibus; anfractu ultimo acutè angulato, basi pluno; umbilico crenulato; columellâ supra tortuosâ, margine reflexâ, crenulatâ, basi dente biplicato terminatâ; labro intus dentibus lamellaribus, superiore majore.*
Hab. Island of Siquijor, under stones (*H. C.*).

3. Clanculus cingulifer, A. Adams. *C. testâ elevato-conoideâ, carneolâ, cingulo albo rufoque articulato ornatâ; anfractibus rotundatis, cingulis transversis granosis sculptis; basi concavâ, peromphalo albo roseo radiato, margine plicato; columellâ crassâ, supra nodosâ, infra uniplicatâ; basi dente triplicato terminatâ; labro intus lirato; tuberculo maximo, prope marginem superiorem.*
Hab. ——?

4. Clanculus maculosus, A. Adams. *C. testâ elevato-conoideâ, rufo-fuscâ, maculis albidis variegatâ; anfractibus rotundatis, cingulis granorum ornatis, interstitiis obliquè striatis, margine umbilici crenulato; columellâ supra tuberculo magno instructâ, basi dente biplicato terminatâ; labro intus lirato, lirâ supremâ maximâ.*
Hab. ——?

5. Clanculus sulcarius, A. Adams. *C. testâ parvâ, albidâ, fasciis fuscis radiatim ornatâ, cingulis distantioribus granorum instructâ, interstitiis longitudinaliter obliquè striatis; anfractibus parum convexis; margine umbilici crenulato; columellâ dente pliciformi; labro intus crenulato.*
Hab. Island of Masbate, sandy mud, 7 fathoms (*H. C.*).

6. Clanculus acuminatus, A. Adams. *C. testâ elevato-conicâ; spirâ acuminatâ, fuscâ, nigro-fusco punctatâ, cingulis transversis subdistantibus granorum ornatâ; interstitiis lineis transversis et longitudinalibus decussatis; margine umbilici subnoduloso; columellâ margine reflexo, integro, basi dente simplici magno terminatâ; labro intus lirato.*
Hab. Sibonga, island of Zebu, under stones (*H. C.*).

7. Clanculus albinus, A. Adams. *C. testâ conoideâ, albidâ, cingulis granorum confertis ornatâ, granis nonnullis fusco punctatis; anfractibus convexis, ultimo rotundato; margine umbilici plicato-dentato; columellâ callosâ, plicis duabus transversis, basi dente triplicato terminatâ; labro supernè inflexo, intus lirato; tuberculo magno trisulcato prope marginem superiorem.*
Hab. ——?

8. Clanculus turbinoides, A. Adams. *C. testâ turbinato-conoideâ, fuscâ, cingulis subdistantibus granorum ornatâ; interstitiis lineis transversis prominulis; anfractibus rotundatis, suturâ canaliculatâ; basi cingulis concentricis granorum instructâ;*

umbilico dentato; columellâ sulcatâ, margine reflexâ, tuberculis quatuor; labro intus lirato.

Hab. ——?

9. Clanculus stigmatarius, A. Adams. *C. testâ elevato-conicâ, cingulis confertis granorum ornatâ, lutescenti cingulo tertio et septimo granis albis et roseis subdistantibus, basi granis roseis ornatâ; umbilici margine subnodoso; columellâ crassâ, transversim subplicatâ, basi dente magno triplicato terminatâ; labro supra inflexo, intus lirato, tuberculo magno bisulcato prope marginem superiorem.*

Hab. Island of Corigidor, bay of Manila, coarse sand, 9 fathoms (*H. C.*).

10. Clanculus textilosus, A. Adams. *C. testâ conoideâ; spirâ acuminatâ, cingulis granorum inæqualibus ornatâ, primo, tertio et sexto coccineâ, secundo, quarto, quinto et septimo granis albis nigris alternantibus ornatâ; margine umbilici dentato; columellâ biplicatâ, margine acutâ, basi dente triplicato terminatâ; labro intus lirato, prope marginem superiorem tuberculo magno.*

Hab. Island of Ticao, sandy mud, 6 fathoms (*H. C.*).

11. Clanculus minor, A. Adams. *C. testâ parvâ, conicâ, albidâ, fasciis rufo-fuscis radiatim ornatâ; anfractibus planis, cingulis transversis granosis sculptâ, anfractu ultimo angulato, basi planiusculâ, margine umbilici crenulatâ; columellâ tuberculo decurvato terminatâ; labro intus lirato.*

Hab. Island of Masbate, sandy mud, 7 fathoms (*H. C.*).

12. Clanculus brunneus, A. Adams. *C. testâ depresso-conicâ, fuscâ, cingulis granorum subdistantibus ornatâ; interstitiis longitudinaliter elevatè striatis; anfractibus planiusculis, ultimo acutè angulato, umbilici margine planâ; columellâ transversim plicatâ, margine fimbriatâ, basi dente biplicato terminatâ; labro intus lirato, lirâ supremâ majore.*

Hab. ——?

13. Clanculus unedo, A. Adams. *C. testâ elevato-conoideâ; spirâ prominulâ, apice roseo, cingulis granorum confertis (in anf. ultim. quinque) ornatâ, coccineâ, cingulo secundo, quarto et quinto granis albis et nigris ornatis; umbilici margine plicato-crenulatâ; columellâ obliquâ, crassâ, margine reflexâ, basi dente magno triplicato terminatâ; labro intus lirato, supra tuberculo magno.*

Hab. ——?

14. Clanculus zebrides, A. Adams. *C. testâ conoideâ, fuscescenti, nigro-fusco radiatim pictâ, cingulis granorum sculptâ; interstitiis lineolis transversis elevatis; anfractibus rotundatis; umbilici margine crenulatâ; columellâ supra tuberculo, margine callosâ, basi tuberculo magno terminatâ; labro intus dentibus linearibus instructo.*

Hab. ——?

15. Clanculus edentulus, A. Adams. *C. testâ orbiculato-conoideâ, sordidè rufâ, albo variegatâ, cingulis transversis gra-*

nosis sculptâ; anfractibus parum convexis; umbilici margine subcrenulatâ; columellâ supra plicatâ, infra edentulâ, margine infra tuberculis tribus; labro intus subsulcato.

Hab. ——?

16. Clanculus nigricans, A. Adams. *C. testâ depresso-conicâ, umbilicatâ, nigricante; anfractibus planis cingulis quinque granulatis ornatâ, ultimo angulatâ, carinis planis duabus in parte inferiore, cingulis* 5–6 *articulatis sulcisque intermediis sculptâ; umbilici margine crenulato; columellâ rectâ, supernè solutâ, in parte superiore tuberculatâ, extus tuberculis tribus instructâ; labro intus lævi.*

Hab. ——?

17. Clanculus carinatus, A. Adams. *C. testâ conicâ, albidâ, flammulis rubris pictâ, anfractibus planis, cingulis inæqualibus confertis granorum ornatâ, supra suturam angulatâ, anfractu ultimo margine carinato, carinâ albo rufoque articulatâ; umbilici margine plano; columellâ rectâ, supra subcallosâ, basi dente simplici acuto terminatâ; labro intus sulcato.*

Hab. ——?

18. Clanculus microdon, A. Adams. *C. testâ orbiculato-conicâ, fuscâ, nigro-fusco maculatâ, cingulis granorum ornatâ; interstitiis lineis elevatis transversis; anfractibus rotundatis, basi cingulis subnodosis, rufo- et nigro-fusco articulatâ; umbilici margine dentato, dente superiore majore; columellâ supra flexuosâ, plicatâ, margine reflexo, sulcato-crenulato, basi dente parvo terminatâ; labro intus lirato.*

Hab. ——?

19. Clanculus omalomphalus, A. Adams. *C. testâ depresso-conicâ, pallidâ, fusco maculatâ, anfractibus paulum rotundatis, cingulis granorum ornatâ; interstitiis striis longitudinalibus, anfractu ultimo acutè carinato, carinâ albo rufoque articulatâ, basi planâ; umbilici margine plano; columellâ transversim plicatâ, margine reflexo dentato, basi dente biplicato terminatâ; labro intus lirato.*

Hab. Sydney (*Strange*).

20. Clanculus gibbosus, A. Adams. *C. testâ depresso-conicâ, pallidâ, fasciis fuscis radiatim dispositis ornatâ, cingulis transversis æqualibus granosis sculptâ; anfractibus rotundatis, suturâ profundâ, canaliculatâ, anfractu ultimo gibboso, infra subangulato; umbilici margine crenulato; columellâ plicatâ, margine reflexo supra dentato, basi dente magno biplicato terminatâ; labro intus corrugato-crenulato, supra inflexo, tuberculo magno instructo.*

Hab. New Ireland (*Jukes*).

21. Clanculus conspersus, A. Adams. *C. testâ orbiculato-conicâ, rufescente, albo rubroque variegatâ, cingulis moniliformibus transversis ornatâ, cingulo infra suturam majore, anfractu ultimo angulato; columellâ postice subcanaliculatâ vix tortuosâ,*

anticè plicâ magnâ transversâ terminatâ; labro intus valdè dentato-lirato.
Hab. ——?

22. Clanculus nodiliratus, A. Adams. *C. testâ depresso-turbinatâ, carneolâ, liris transversis nodulosis subdistantibus ornatâ; interstitiis longitudinaliter tenuissimè striatis; anfractibus subquadratis, margine umbilici dentato; columellâ rectâ, anticè tuberculo parvo terminatâ; labro intus lirato.*
Hab. ——?

MISCELLANEOUS.

Observations on the Breeding of the Nightingale in Captivity.

By H. Hanley, Sergeant-Major 1st Life Guards.

Being of opinion that any bird which breeds in this country in a wild state, might, by studying its habits, be brought to do so in a state of captivity, I made preparations during the winter of 1844 for trying the Nightingale, which I considered to be the most retired in its habits of any of our summer visitants. I had a cage made, 4 feet long by 3 feet high, the back, ends and top solid, with a wire front, in which I placed a small Scotch fir-tree, planted in a flower-pot; to each end of the cage I attached a common-sized canary's breeding-cage, communicating with the large cage by a hole about 4 inches square. I broke a new birch-broom, and filled up the cages at each end, to make them resemble as near as possible the bottom of a thick hedge, and then put in a plentiful supply of withered oak-leaves and moss, of which the nightingale forms its nest, covering the fronts of the two small cages with green glazed calico: I placed the cages high up against a wall facing a landing-window. The following spring, that is, about the latter end of April 1845, I directed a bird-catcher (Blake, of John-street, Tottenham-court-road), who goes to Watford every season to catch nightingales, to bring me a cock and hen bird which had paired naturally; he did so, and, fortunately, they meated off very readily. By "meating off," I mean that such birds as live on insect food will not peck at dead food until taught to do so, which is effected by enclosing meal-worms in a small glass tube, corked up at each end, and then placing the tube in their food; on pecking at the worm the beak slips off the glass amidst the food, which they swallow, and will afterwards go to it without the aid of a tube. On finding my birds feed freely in the small cage, in which until then I had confined them, I turned them into the place I had fitted up for them, and was much gratified, about a week afterwards, to observe the hen bird flying about with an oak-leaf in her beak. She made her nest in one of the small cages at the end of the large one; laid four eggs, of which she hatched and brought up three young ones. During the time she was sitting, the cock sang as well and as loud as I ever heard one in a wild state: when the young were excluded he left off singing, and was most assiduous in assisting to feed and rear them. —*Proc. Zool. Soc.* June 10, 1851.

EUCRATEA CHELATA.

To the Editors of the Annals of Natural History.

6 North Parade, Penzance, June 4, 1853.

Gentlemen,—On June 17, 1852, I found this pretty Zoophyte trailing over the pods of *Halidrys siliquosa*, washed in beneath the Hoe, Plymouth. On examining it under the microscope I found what I then supposed to be ovicells. Shortly after I saw Mr. Hincks in Exeter, when I told him that I had met with them, at which he seemed surprised and somewhat doubtful. I promised to send him some specimens, which he has so well described and delineated in the Annals for March last. I have lately been able to confirm all his remarks upon them, as during the past month (May 1853) I have met with them in much greater abundance, and springing frequently from the polypidom.

The zoophyte is plentiful on the outside of the bulb of *Laminaria bulbosa* from St. Ives Bay on the north coast of Cornwall. I have also succeeded in obtaining a view of the polype. The number of tentacula are about ten. The polype is of a shy disposition and does not protrude far from the cell, and appears to be slow in all its movements. I shall have much pleasure in supplying the ovicells to any person who may be desirous of possessing them. Mr. Busk, in the Catalogue of the Marine Polyzoa of the British Museum, has named this species *Scruparia chelata*.

I remain, Gentlemen, your obedient servant,

William F. Templer.

On a new species of Bulimus. By Lovell Reeve, F.L.S.

Bulimus Maconelli. *Bul. testâ acuminato-oblongâ, tenuiculâ, subobliquè convolutâ, spirâ brevi, suturis rudibus, anfractibus quatuor ad quinque, minutè et creberrimè spiraliter undulato-striatis, ultimo valdè inflato, columellâ subcontortâ, aperturâ subamplâ, labro simplici; brunneâ, maculis parvis punctisque nigris undique pictâ et seriatim fasciatâ, maculis infra suturas regularibus, aperturæ fauce fuscescente.*

Hab. Brisbane, Moreton Bay, Australia.

This fine species has been forwarded to me from the Manchester Museum of Natural History, with the above name attached to it in manuscript, by Captain Brown. It is chiefly remarkable on account of its absolute similarity in texture, in colour, and in pattern, to *Helix Falconari* of the same locality. It appears to differ in nothing but in that difference of convolution which characterizes the respective genera. Mr. Cuming possesses an exactly similar un-umbilicated specimen; and none of several examples of *H. Falconari*, with which it has been compared and which are all largely umbilicated, present any indication of an intermediate form. It is the first instance on record of a strictly typical richly painted *Bulimus* and *Helix* agreeing in colour, in pattern, and in all respects save that of form.—*Proc. Zool. Soc.* June 24, 1851.

JOHNSTONELLA CATHARINA, GOSSE. THE CRYSTALLINE JOHNSTONELLA.

Mr. Gosse, in his amusing and interesting work on the coast of Devonshire, describes as new to science an animal under the above name. I am sorry,—as I should much wish for the above name to have been permanent,—to have to observe that it appears to belong to the same genus as the animal described by Eschscholtz in the 'Isis' (1825), p. 736. t. 5. f. 5, under the name of *Tomopteris onisciformis* from the South Seas; and by MM. Quoy and Gaimard in the 'Voyage of the Astrolabe,' ii. p. 284. t. 21. f. 21, 24, under the name of *Briaræa Scolopendra* from the coast of Spain. Hermannsen has proposed to change the latter name to *Briaræa*: Harry Goodsir calls it *Briareus*: and Mr. R. Ball writes it *Bryarea*. Eschscholtz and Quoy and Gaimard regard it as a mollusk; the first referring it to the order *Heteropoda*, and the latter to the *Nudibranchiata*.

Mr. Harry Goodsir, who found the animal abundant in the North Sea (Ann. and Mag. Nat. Hist. 1845, xvi. 163), observing the presence of "cilia fringing the bifurcated posteriors of the lateral extremity of its body," decided that it could not be a mollusk.

Menke (Zeitsch. für Malac. 1844, 21) proposes to remove the genus to the Annelides; more recent authors have considered it as a Crustacean.

Mr. Gosse at first sight thought it might be a Brachiopod Crustacean, but thinks it has more affinity to the Annelides (p. 348), and refers it to that class in the Systematic Index.

According to Eschscholtz and Quoy and Gaimard, the South Sea specimens are very much smaller than those found in the Mediterranean: thus, *Tomopteris onisciformis* and *T. Scolopendra* are most probably distinct species. Mr. Gosse's *Johnstonella Catharina* is, no doubt, a synonym of the latter, since Mr. R. Ball records that *Bryarea Scolopendra* has been taken in Dublin Bay by Dr. Corrigan (Proc. Brit. Assoc. 1849, p. 72).—John Edw. Gray.

July 14, 1853.

On a new genus of Anomiadæ. By J. E. Gray, F.R.S. &c.

TEDINIA.

Shell irregular, loosely lamellar; upper or right valve with a broad cardinal groove, and with three muscular scars, the upper small, oblong near the cartilage, the other two large, subcentral, upper subtrigonal, lower oblong, transverse, united by a nearly straight medial cross line; left or attached valve with an elongated, triangular, convex cardinal ridge, with a deep groove on each side, having the cartilage on its inner edge, with two muscular scars, one small, half oblong near the cardinal ridge, the other large, subcentral, subcircular, and with a roundish circular hole near the upper edge, with a slight impression showing the grooves to the margin some distance from the cardinal ridge; the plug shelly, fixed into and exactly fitting the hole, with a triangular base sunk into the surface, commencing from the apex of the shell on the outer surface, and formed of erect shelly longitudinal plates within.

The shell has the plug and much the external appearance of the subgenus *Pododesmus*, but differs from it and all the other *Anomiadæ* in the following particulars: 1. That the line which indicates the junction of the two edges of the sinus which forms the perforation, instead of being placed on the side of the ridge which supports the cartilage, is placed at a considerable distance from it; 2. The sides of the sinus are firmly soldered together, leaving only a circular hole; 3. The support of the cartilage, instead of being merely a ridge or process, here forms a large elongated subtriangular talus, like that found in the genus *Ostrea*; 4. It differs greatly in the number and form of the muscular scars; the two large ones in the free valves are placed as in the genus *Placunanomia*, and there is a third anterior one in each valve not found in any genus of the family, and very unlike the third scar of the genus *Anomia*. I know only of a single specimen of the genus, which is in the collection of Mr. Cuming, who believes that it came from California. It may be called *Tedinia pernoides*; subquadrangular, reddish, subsquamose, obscurely radiated, internally reddish brown.—*Proc. Zool. Soc.* June 24, 1851.

METEOROLOGICAL OBSERVATIONS FOR JUNE 1853.

Chiswick.—June 1. Overcast: slight rain. 2. Cold haze: overcast: heavy clouds. 3. Fine: clear. 4. Slightly overcast: cloudy and fine: clear. 5, 6. Very fine. 7. Hazy: very fine. 8. Very fine: overcast. 9. Cloudy and mild. 10. Fine. 11. Slight haze: fine. 12. Overcast: rain. 13. Constant rain. 14. Cloudy. 15. Very fine: heavy clouds: overcast. 16. Very fine: clear. 17. Cloudy and fine. 18. Fine. 19. Rain. 20. Very fine: cloudy and showery at night. 21. Very fine: rain: clear. 22. Cloudy: slight rain. 23. Fine: clear at night. 24. Very fine: clear. 25. Rain: cloudy: rain. 26. Overcast: rain at night. 27. Densely overcast: slight rain. 28. Overcast. 29. Cloudy and fine. 30. Showery.

Mean temperature of the month	59°·16
Mean temperature of June 1852	58 ·01
Mean temperature of June for the last twenty-seven years	60 ·56
Average amount of rain in June	1·77 inch.

Boston.—June 1—5. Cloudy. 6. Fine: rain P.M. 7, 8. Fine. 9. Cloudy. 10—13. Fine. 14. Cloudy: rain, with thunder and lightning P.M. 15. Fine. 16. Cloudy. 17. Fine. 18. Cloudy. 19. Rain: rain A.M. and P.M. 20. Fine: rain P.M. 21. Cloudy: rain P.M. 22. Cloudy: rain A.M. and P.M. 23. Cloudy. 24. Fine. 25. Cloudy: rain A.M. 26, 27. Cloudy: rain A.M. and P.M. 28. Cloudy: rain A.M. 29. Fine: rain A.M. 30. Cloudy: rain P.M.

Sandwick Manse, Orkney.—June 1. Fog A.M.: damp P.M. 2, 3. Drops A.M.: cloudy P.M. 4. Cloudy A.M. and P.M. 5. Clear A.M.: cloudy P.M. 6. Cloudy A.M.: showers, fine P.M. 7. Clear, fine A.M.: clear P.M. 8. Clear A.M.: hazy P.M. 9. Drizzle A.M.: showers, fog P.M. 10. Fog A.M. and P.M. 11. Fog A.M.: showers, hazy P.M. 12. Hazy A.M. and P.M. 13. Bright A.M.: clear, fine P.M. 14. Bright, fine A.M.: cloudy P.M. 15. Showers A.M.: cloudy P.M. 16. Cloudy A.M.: cloudy, fine P.M. 17. Cloudy A.M.: rain P.M. 18. Rain A.M.: cloudy P.M. 19. Bright A.M.: rain P.M. 20. Damp A.M.: clear, fine P.M. 21. Clear, fine A.M. and P.M. 22. Clear, fine A.M.: fog P.M. 23. Damp A.M.: clear P.M. 24. Showers A.M. and P.M. 25. Showers A.M.: clear P.M. 26. Bright A.M.: clear P.M. 27. Rain A.M. and P.M. 28. Bright A.M.: cloudy P.M. 29. Rain A.M.: showers P.M. 30. Cloudy A.M. and P.M.

Mean temperature of June for twenty-six previous years	52°·69
Mean temperature of June 1852	55 ·33
Mean temperature of this month	55 ·21
Average quantity of rain in June for seven previous years	2·46 inches.

Meteorological Observations made by Mr. Thompson *at the Garden of the Horticultural Society at* Chiswick, *near London; by* Mr. Veall, *at* Boston; *and by the* Rev. C. Clouston, *at Sandwick Manse,* Orkney.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston. 8½ a.m.	Orkney, Sandwick.		Chiswick.		Boston. 8½ a.m.	Orkney, Sandwick.		Chiswick. 1 p.m.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1853. June.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
1.	29·967	29·934	29·60	30·08	30·12	57	48	52	59	51	n.	nne.	nw.	·02	.....	.....
2.	30·091	30·061	29·70	30·18	30·25	60	46	55	56	50½	n.	n.	wnw.	.....	.....	.....
3.	30·127	30·080	29·80	30·22	30·18	64	37	55	55	51	ne.	nne.	nnw.	.....	.....	.....
4.	30·040	29·911	29·65	30·13	30·03	64	39	56·5	56	50	ne.	n.	ese.	.....	.....	.....
5.	29·896	29·848	29·50	29·90	29·83	69	39	58	57	52	se.	nne.	ese.	.....	.....	.....
6.	29·883	29·836	29·47	29·83	29·90	74	39	62	56	55½	sw.	sse.	e.	.....	.....	.....
7.	30·000	29·942	29·55	29·99	30·03	75	44	58	57	53	nw.	n.	ese.	.....	·10	·08
8.	30·078	30·014	29·62	29·95	29·94	80	54	62·5	58	53	sw.	w.	ese.	·02	.....	.....
9.	30·047	29·973	29·55	29·95	30·02	69	50	71·5	56	56	sw.	w.	se.	·01	.....	.....
10.	29·949	29·813	29·45	29·94	29·87	83	57	70	56	53	se.	ese.	se.	·02	.....	·10
11.	29·743	29·690	29·30	29·83	29·82	80	53	69	55	54	e.	e.	se.	·10	.....	.....
12.	29·728	29·707	29·24	29·84	29·94	65	51	72·5	60	54	w.	se.	ese.	·20	.....	·04
13.	29·753	29·702	29·26	30·00	30·02	55	51	63	62	54	w.	e.	ese.	·77	.....	.....
☽ 14.	29·937	29·881	29·33	29·92	29·84	71	48	64	60	54	s.	nw.	w.	·36	.....	.....
15.	30·007	29·961	29·48	29·88	29·95	70	55	70	56	51½	sw.	ssw.	w.	.....	·25	·05
16.	30·037	29·985	29·53	29·96	29·96	82	48	73	56	55	s.	sse.	se.	.....	.....	.....
17.	30·052	30·006	29·50	29·81	29·79	75	49	64·5	61	56	w.	s.	se.	.....	.....	.....
18.	30·001	29·869	29·46	29·60	29·65	71	53	68	59	56	sw.	ssw.	se.	.....	.....	·15
19.	29·728	29·553	29·17	29·60	29·64	64	41	63·5	62	56	sw.	s.	.....	·32	·36	.....
20.	29·556	29·531	29·13	29·71	29·91	68	44	55	59	55½	ne.	nw.	e.	·02	·79	·31
○ 21.	29·677	29·586	29·20	29·95	29·99	60	43	53	62	54½	n.	s.	ne.	·04	·01	.....
22.	29·780	29·694	29·36	30·03	30·02	64	50	60	62	52	n.	nw.	wnw.	·01	·12	.....
23.	29·790	29·745	29·37	29·90	29·82	73	47	61	55	49	n.	n.	.....	.....	·07	.....
24.	29·820	29·751	29·30	29·70	29·64	81	56	68·5	55	49½	sw.	w.	nw.	·06	.....	·11
25.	29·748	29·603	29·24	29·56	29·59	69	55	53	53	48	sw.	wnw.	nw.	·18	.....	·30
26.	29·656	29·528	29·20	29·59	29·48	67	53	59	57	50	w.	nnw.	ne.	·36	·03	.....
27.	29·616	29·573	29·08	29·34	29·26	69	59	66·5	55	54	sw.	w.	wsw.	·01	·47	.....
☾ 28.	29·677	29·576	29·16	29·36	29·22	71	53	66	58½	54	sw.	s.	e.	.....	·23	·31
29.	29·745	29·654	29·10	29·06	29·32	71	50	64	53½	54	sw.	wsw.	w.	.....	·02	·62
30.	29·728	29·664	29·23	29·37	29·43	70	47	65·5	56	54	sw.	sw.	w.	·04	·01	·06
Mean.	29·861	29·789	29·38	29·806	29·815	69·70	48·63	62·6	57·43	53·00				2·54	2·46	2·13

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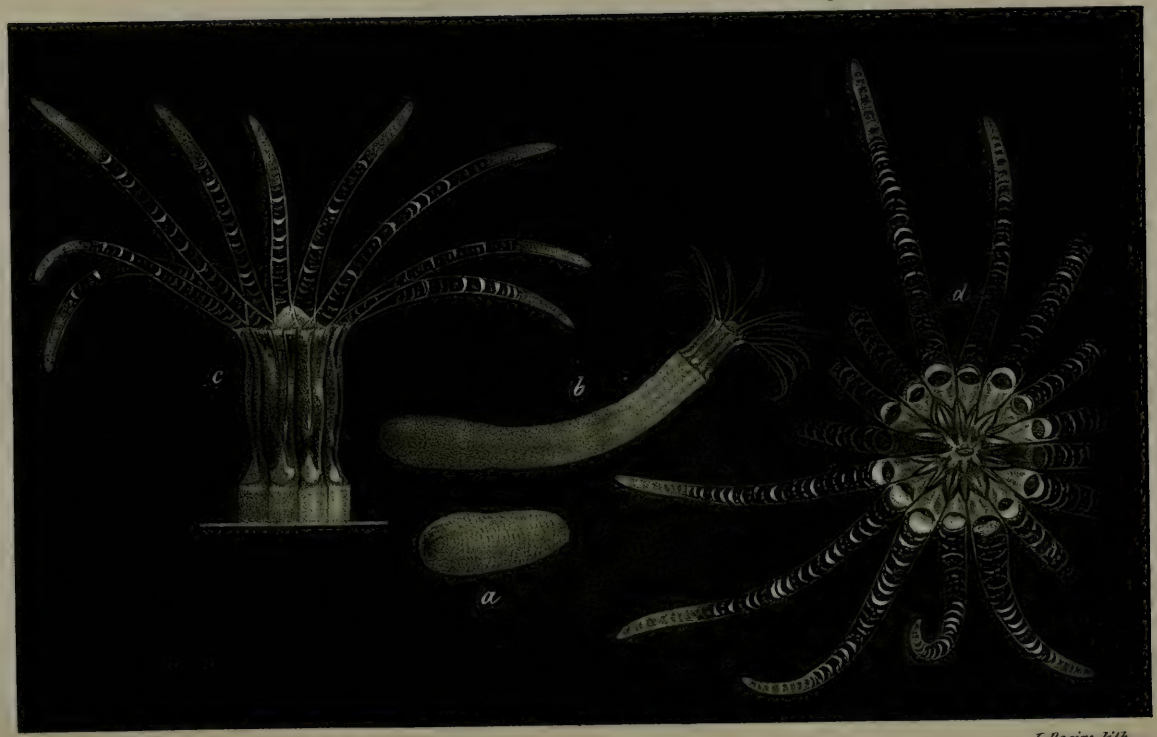

P.H.Gosse del.

Scolanthus callimorphus.

J. Basire lith.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

No. 69. SEPTEMBER 1853.

XVI.—*Notes on some new or little-known Marine Animals.* (No. 2.) By P. H. Gosse, A.L.S.

[With a Plate.]

Class CRUSTACEA.

Fam. Palæmonidæ.

Hippolyte fascigera (mihi). The Plumed Hippolyte.

Rostrum straight, acuminate, with two teeth above, the one at the base and the other near the apex; two teeth below, the one near the middle, the other near the tip. Body studded with deciduous tufts of plumes.

This curious species attains about $\frac{7}{8}$ths of an inch in length. The carapace is moderately gibbous; the rostrum straight, elongated, furnished on its upper edge with a curved tooth near the base, and a second small one so close to the extremity, that the tip might almost with propriety be called bifid; the tip itself is acute, and extends a little beyond the apical tooth; on the under edge, which is much hollowed at the base, and deep in the middle, there are two teeth, of which one is a little beyond the middle, and the other near the tip, but considerably behind the line of the upper apical tooth. The scale of the external antenna is large, exceeding the rostrum by one-third of its own length; its tooth is placed about one-fifth from the extremity. The thicker filament of the internal antenna is comparatively slender, not longer than the thin filament, and bent up at a right angle. The first pair of feet are short; the second has the wrist four-jointed. The middle plate of the tail has two spines on each side, and six placed slightly divergently at its extremity, of which the outermost on each side is minute.

The most remarkable character is that each segment of the

body is armed with six tufts of plumose bristles, set transversely at nearly equal distances. The thorax has three transverse rows, and the abdomen one on every segment. Each tuft consists of from ten to fifteen plumes, which spring from a point and diverge in a fan-like manner in the longitudinal plane. Each plume is a slender straight taper stem, set distichously with two rows of very close pinnæ, diverging at a small angle from the stem, and graduated to a point, like the barbs of a feather. These plumose tufts are very peculiar, and are sufficiently conspicuous during life even to the naked eye; though, being very deciduous, it is rare to find the whole series perfect, and in dried specimens they are frequently altogether wanting. In this condition the species may be easily mistaken for *H. varians*, which it resembles closely in many of its characters, besides the form and denticulation of the rostrum. It may, however, be distinguished at once, while alive, by its colour, which, though varying, does not assume any of the phases of *H. varians*. It is usually pellucid white, clouded with opake drab, and generally blotched with dark reddish purple. When dead, and divested of its tufts, the rostrum displays minute but constant points of difference, in the closer proximity of the upper and lower apical teeth to the apex, and in the wider separation of the two lower teeth *inter se*. The relation of the filaments of the internal antennæ to each other, in length and thickness, also affords a good distinction; but not the direction of the thicker; for though this in *H. varians* is stated by Professor Bell not to be bent at right angles, I must venture to correct this observation; its angle, according to my experience, is as abrupt during the life of the animal as it is in *H. Cranchii* for instance.

Hippolyte fascigera is taken with the dredge in Weymouth Bay a few miles from land; though less numerous than some other species of the genus, it cannot be considered rare.

Hippolyte Cranchii (Leach). Cranch's Hippolyte.

The colours of this little species when alive, taken by comparison of several specimens, are as follows. Upper parts nearly white, the rest light pellucid purple, in which the blue or the red element prevails in irregular patches. The hue is most positive on the legs, where it is banded, on the terminal segment of the abdomen, on the tail-plates, and on the false feet. In other parts it is seen by means of a lens to consist of minute stellate specks on a light ground. The extruded ova, which form a large mass, are white, becoming olive. Sometimes the whole animal is of a pellucid drab hue, with scattered purple specks. I have seen a specimen which was wholly of a deep purple, except

the thorax, which was alternately banded with brown and pale yellow, and the eyestalks, which were pale yellow. A narrow band of whitish drab running along the median line of the abdomen, and expanding into a broad oval spot on the fourth segment, is pretty constant in all, and may be considered characteristic.

The rostrum has four teeth on the upper edge, quite as often as three, if not oftener; and the extremity is occasionally trifid.

This is one of the most common of the smaller Crustacea inhabiting the deeper parts of the coralline zone in Weymouth Bay. It is brought up in almost every haul of the dredge or keer-drag.

Hippolyte Thompsoni (Bell). Thompson's Hippolyte.

The denticulations of the upper edge of the rostrum in this Prawn are not simple serratures of the edge as in *Hip. Cranchii*, and in the true *Palæmons*, but triangular spines articulated to the edge. In *Pandalus annulicornis* the same structure exists, and the superior size of this latter species facilitating manipulation, I found that by means of a fine needle I could move the spines to and fro with considerable freedom, on their articulated bases. The spaces between the spines are occupied in both these species by rows of short bristles graduated in length, as in *Palæmon serratus*.

Crangon sculptus (Bell). The Sculptured Shrimp.

This pretty species varies exceedingly in colour. In one of its most common conditions, the ground colour is a plain drab, which is studded with minute blackish dots, and stellate specks of reddish brown. The body, especially the abdomen, is elegantly clouded with pale sienna-brown in a sinuous but symmetrical pattern. The sinuosities are in some parts edged with pale blue, and there are three more conspicuous spots of bright azure blue, set at equal distances along the median line of the abdomen, each of them taking the form of a semi-ocellus with a black pupil. An undulating line or macular band of azure crosses the front of the thorax. The ground colour of the fourth abdominal segment is of a deeper brown than the rest, the difference being gradual anteriorly but abrupt posteriorly, where it ceases with a transverse line of deep brown, imparting some resemblance to *C. fasciatus*. Sometimes there is a broad well-defined band of deep brown across the hinder part of the thorax. One specimen that I have seen had the whole upper parts opake white, minutely freckled with buff; except the last abdominal segment and the tail-plates, which, as well as the sides of the body and the false feet, were freckled with blackish purple.

Another had the buff of the upper parts so mingled with rufous, purple and dark brown, as to give a warm bay tint to the whole, with azure spots scattered, and a broad band of deep bistre brown across the hind part of the thorax.

Another is about equally clouded and banded with black and rose-crimson; exceedingly rich and beautiful.

The projection of the wrist of the anterior foot on each side, like an angular elbow, gives a peculiar aspect to this little shrimp.

Crangones vulgaris, trispinosus, sculptus, fasciatus, and *spinosus* occur in this bay with a comparative frequency indicated by the order in which I have placed their respective names.

Fam. Mysidæ.

Mysis productus (mihi). The Long Opossum Shrimp.

Form elongate, slender. Rostrum lanceolate, nearly twice as long as the eyes. Peduncle of internal antenna elongate, curving outward; second and third joints together as long as the first. Scale of external antenna about half as long as the carapace, strongly toothed.

The general form is much longer and more slender than that of *M. chamæleon*. The rostrum is hyaline, broadly lanceolate, acute, and nearly twice as long as the eyes. All the joints of the peduncle of the internal antenna are lengthened; the second and third united are equal to the first, and together reach about to the tip of the antennal scale. This latter is lengthened; nearly parallel-sided, with the tip abruptly angular; a strong tooth projects from the outer angle, from whence long cilia extend round the tip along the inner edge. Pl. VI. fig. 5 *a*.

The middle plate of the tail (fig. 5 *b*) is lanceolate, with the apex entire, obtuse; the base constricted; the margin fringed with small spines. The inner lateral plate tapers to a point, with a terminal spine. The outer plate is by much the longest, it is emarginate on the outside near the tip; the inner edge is deeply ciliated, the fringe extending round the tip to the emargination; there a rather long spine occurs, followed by a series of minute spines to the base.

The colour of the only specimen found was pale umber-brown, becoming redder towards the tail. The outer tail-plate was hyaline, with a large stellate spot of red on its basal half. Eyes black. It was taken in Weymouth Bay in July, together with several of *M. chamæleon*.

The species appears to combine some of the characters of *M. Griffithsiæ* and *M. vulgaris*, but to be sufficiently distinct from either.

Class ZOOPHYTA.

Fam. Actiniadæ.

Genus Scolanthus (mihi). The Worm-Anemone.

Body cylindrical, lengthened, vermiform, invertile, incapable of attachment; posterior extremity rounded, perforate; anterior discoid, surrounded by a marginal series of slender tentacles. Name from *σκώληξ, a worm,* and *ἄνθος, a flower.*

Scolanthus callimorphus (mihi). The Yellow Worm-Anemone.

When contracted this animal is about three-fourths of an inch long, and one-third of an inch in diameter, covered with a coriaceous, minutely corrugated skin, of a deep orange-yellow colour. (See Pl. X. fig. *a.*) In this state it bears a strong resemblance to a *Holothuria,* which indeed for some time I supposed it to be. On being placed in a glass vase of sea-water with a layer of gravel at the bottom, it speedily burrowed out of sight. The next morning, however, I perceived it greatly changed, being fully expanded. It had fortunately selected a site in contact with the side of the glass, so that I could see the whole length of the animal through the transparent medium.

When fully protruded it extends to about $2\frac{1}{2}$ inches, with a slight diminution of the former diameter. (See fig. *b.*) The anterior extremity for about one-third of an inch forms a sort of fluted column, a little less in thickness than the rest of the body, from which it is abruptly separated. The flutings, eight in number at the base, but divided into sixteen at the summit, are of a rich sienna-brown hue, varied irregularly with black and white, each bearing a conspicuous lozenge-shaped spot of cream-white at the base, and terminated by a white tip. The effect of these colours is bizarre, and much resembles those mosaics of coloured woods well known as Tunbridge-ware. (See fig. *c.*)

The extremity of the coloured column is truncate, forming a transverse disk, in the centre of which is a small, ovate, conical mouth, agreeing in structure with that of the *Actiniæ* generally. The surface of the disk is white, marked with a series of pointed arches in form of a star of deep sienna-brown; the regularity and beauty of which figure, resembling the forms of the kaleidoscope, so struck my imagination as to suggest the specific name, from *καλὸς, beautiful,* and *μορφὴ, form.* From each angle of the mouth a broad band of blackish brown crosses the disk, interrupting the star at opposite points. (See fig. *d.*)

Sixteen depressed radiating lines on the disk mark the outlines of the basal portion of so many tentacles, which become free only at the edge of the disk. They are long, slender, and of

nearly equal diameter throughout, but taper to a blunt point at the extremity. Their substance is of colourless transparency, with the exception of transverse rows of specks and dashes of opake white, more or less arranged in rings, increasing in number and size, until they become confluent at the tips; this glassy translucency imparts to the tentacles a singular effect, especially as the part where they become free and spring from the margin of the disk is marked by an abrupt circle of opake white. Each tentacle is about thrice as long as the disk is wide. These organs radiate horizontally, and commonly are curved either upward or downward at their tips. Their bases coincide with the flutings of the column.

The specimen which I have described was dredged in four or five fathoms in Weymouth Bay, about the end of July. Its habit, judging from what I have seen of it in captivity, is to burrow in fine gravel or sand at such a depth as allows it to protrude the coloured column from the surface (as shown at fig. *c*). Here it expands its tentacled disk for passing prey: I fed it with fragments of a shrimp, and found that it ate with the same avidity, and in exactly the same manner as its cousins, the Sea-Anemones; the tentacles catching and moving to and fro the morsel, and disposing its position and direction so as to facilitate the mouth's grasping it; this latter organ expanding its flexible lips to an apparently indefinite width, and gradually enveloping the presented food.

If rudely touched, the disk was suddenly withdrawn, the column, and then the upper two-thirds of the body disappearing in rapid succession by a process of inversion, exactly like that by which the Earthworm withdraws its fore parts, or, to use a homely simile, like the turning of a stocking. The extent to which the introversion proceeds depends on the degree of annoyance to which the animal has been subjected, or on its wayward will: it is capable of crawling along in its subterraneous abode, while contracted; pushing aside the gravel with the front of its body: it proceeded in this way two or three inches in as many hours, while I was watching it, before it turned upwards and thrust out its head; the evolution of the column not beginning until the surface was reached.

The form and habits of this animal had appeared to warrant its isolation from any genus known to me; it is most nearly affined to *Iluanthos* of Professor Forbes, but seemed to me sufficiently distinct from that genus, before I was aware of the presence of an anal orifice. This is a peculiarity (probably connected with its elongate form) which at once isolates it from its fellows. The aperture is moderately large, of a deep black, which hue appears to be derived from the colour of the fæces

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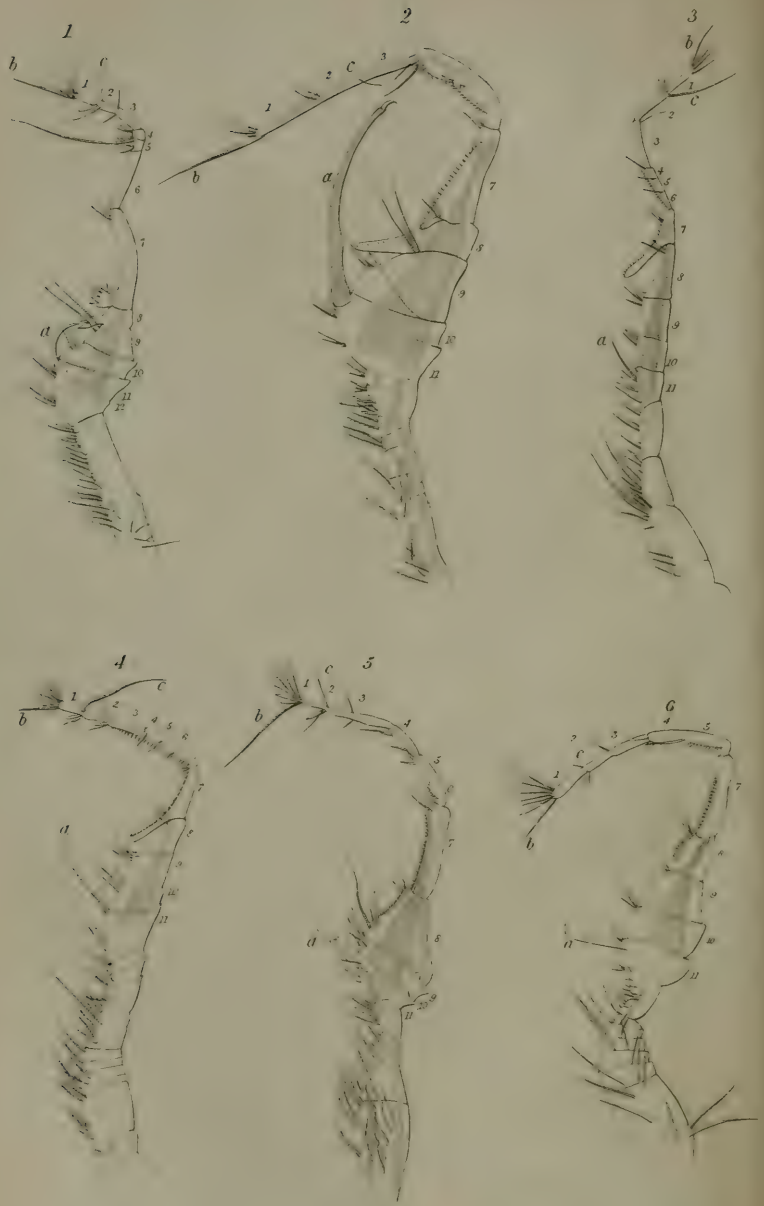

J. Lubbock, del.

J. D. C. Sowerby

staining the surrounding skin; it is seated in a depression in the centre of converging corrugations. On irritating this part slightly, the tortuous frilled bands (commonly called seminal) that occupy so large a portion of the interior of all *Actiniadæ* were protruded. I examined a very minute portion of one with the microscope, and found it to contain a few elliptical thread-capsules, which presented nothing peculiar.

I presume that the usual membranous septa run down the interior cavity; for pale longitudinal lines are seen through the dimly-pellucid integuments of the body, which appear to indicate such a structure.

The skin is coriaceous, not mucous, but covered with minute irregularly-transverse corrugations, as if it lay excessively loose, and was wrinkled up.

P. H. Gosse.

Weymouth, August 5, 1853.

XVII.—*On two new species of* Calanidæ, *with Observations on the Spermatic Tubes of* Pontella, Diaptomus, *&c.* By John Lubbock, Esq., F.Z.S.

[With a Plate.]

[Continued from p. 124.]

Antennæ.

Although the right anterior antennæ of the males of *Labidocera Darwinii, magna* and *Patagoniensis, Pontella Bairdii, Anomalocera Patersonii* and *Monops grandis,* appear at first sight to differ very materially from one another, and from the corresponding antennæ of the left side, which, on the other hand, agree with those of the female, a little examination will prove that they are all reducible to one type, and that their differences are formed by the development of certain parts at the expense of others. I have therefore, when describing the above species, said little about these organs, intending to consider them all together. Extraordinary as are the forms, and beautifully adapted as is the prehensile apparatus of each, yet that which has struck me most is the regular arrangement of the hairs, of which there are five sorts.

1st. Short down, which I have only found on the external side of the basal segments of the female and left male. I never saw any on the right antennæ of the male.

2ndly. The plumose hairs so prevalent among the Entomostraca, and which chiefly prevail at the basal portion and the

apical segment, being apparently replaced from the 1st to the 12th segments inclusive (counting from the apex) by

3rdly. Ordinary, cylindrical tapering hairs, and

4thly. By transversely wrinkled hairs. These two last gradually pass into one another, and though generally perfectly distinct, yet it is sometimes difficult to know to which form the smaller hairs belong. And

5thly. Flattened lanceolate hairs. Hairs of this shape are represented on the antenna of a *Calanus quinqueannulatus* in Gaimard's 'Voyage en Scandinavie,' but I do not remember ever to have seen similar ones on any other animals.

The normal arrangement of these hairs is three on each segment, all on the inner side. I have already observed, however, that the short down is, when present, on the outer side. The exceptions to this rule are the three apical segments, of which the terminal bears seven hairs; and the other two have each one on the outer side in addition to those on the inner. These two hairs (Pl. VII.) are very conspicuous in *Cetochilus septentrionalis*, *Calanus communis*, and *Oithona setiger*, Dana, and are also present in *Pontella*, *Acartia*?, Dana, *Catopia*, Dana, *Caudace*, Dana, *Undina*, Dana, *Euchæta*, Dana; in short, I believe they will be found throughout the family. The plumose, wrinkled and ordinary hairs appear often to pass gradually into one another, the secondary setæ becoming further and further apart, and the wrinkles less and less distinct; they also often replace one another, the plumose prevailing on the apical and the twelve basal, and being almost entirely absent on the intermediate segments. On the other hand, the lanceolate hairs are much more constant and definite in form; there is not one on every segment, but wherever a segment is provided with its three hairs, one is lanceolate, and to this rule I know of no exception. The other two are generally (in that part of the antenna containing the second and eleven following joints to which our attention is now chiefly directed) one ordinary and one wrinkled, sometimes however two wrinkled or two ordinary. I have already remarked that each segment, except the three anterior, is normally provided with three hairs, the apical with seven, and the second and third with four each. The number is often less, but never more than this. In the ordinary unswollen antenna, two of the hairs, one of which is the lanceolate, are attached to the upper end, and one to the middle of each segment, but in the swollen prehensile antennæ they are all found at the apex.

In the females, and in the left antenna of the males, we find on the eleventh segment a strong hair larger than the rest, and evidently homologous with the hair marked (*a*) on *Pontella Bairdii*. This again as evidently represents that marked (*a*) on

L. Darwinii, P. Bairdii, A. Patersonii, M. grandis, and *L. Patagoniensis*; and finally, the large annulose appendage of *L. magna,* in which it attains to its maximum development. If now we count the segments from the apex in *A. magna,* we shall find that it is apparently situated on the ninth; two therefore are evidently either soldered together or missing, and at the same time the fourth shows traces of consisting of three; in *M. grandis* the apical one of these three is distinct from the other two, and in *L. Darwinii* there are transverse lines, which divide it into three segments, but are very indistinct. We have now therefore reduced the twelve anterior segments of the prehensile and non-prehensile antennæ in the two sexes to the same type, and no doubt the same might be done with the basal portion; here, however, the joints are much more indistinct, and differ with age; I have not therefore thought it worth while to devote to this inquiry the time which would be necessary to work it out satisfactorily, but will content myself with a description of the apical portion, especially dwelling on the law which has evidently presided over the arrangement of the hairs.

The three first or *apical* segments are always somewhat alike, small and either distinct as in *P. Bairdii,* or soldered together as in *L. magna*; in either case, however, the boundaries are well marked by the hairs. On the first, these are seven in number. The most internal is the largest, and is either simple or wrinkled; the next is simple or plumose, the third *always* lanceolate, and the rest either simple or plumose. In some cases these hairs are so delicate, that I could not quite convince myself that they agreed with the above description, and in my single specimen of *L. magna* several had unfortunately been broken off. I know of no case, however, which *disagrees* with this rule.

The second segment has in every case three hairs, two internal and one external. One of the two internal is always lanceolate; the other two either simple or ringed.

The third bears one internal and one external, either simple or ringed. In *L. Patersonii,* however, the external is plumose.

The following segments are provided with hairs on the *outer* side only:—

The fourth segment, which in *L. Patagoniensis, P. Bairdii, L. magna,* and *M. grandis,* is intimately united with the two following, bears a simple hair in *A. Patersonii,* a wrinkled one in *L. Darwinii* and *P. Bairdii,* and two wrinkled and a small spine. This spine I consider, not as homologous with a lanceolate hair, but rather as a rudimentary plate, of the same nature as those which are more developed and provided with teeth in the succeeding segments.

The fifth bears a lanceolate hair in *L. magna, Patagoniensis* and

Darwinii, *P. Bairdii* and *M. grandis*, and a simple one in *A. Patersonii*. It is also provided with a dentated plate in *L. Patagoniensis* and *magna*, with a spine (analogous to a plate) in *M. grandis* and *A. Patersonii*; and perhaps a part of the large anterior plate of *L. Darwinii* and *P. Bairdii*, which rises from the next segment, may be considered to belong to this.

The sixth has a lanceolate hair in *L. Darwinii* and *P. Bairdii* only, and bears a dentate plate in every species except *L. Patagoniensis*.

The seventh has a dentate plate in every species, and with the preceding forms the most important part of the prehensile apparatus, the teeth being turned in such a direction as to retain firmly any object seized.

The eighth has two hairs, one lanceolate and the other generally ringed, but sometimes simple, and also either a dentated plate, as in *L. Patagoniensis* and *magna*, *M. grandis* and *A. Patersonii*, or a spine as in *L. Darwinii* and *P. Bairdii*. This is the first segment of the swollen portion, which includes the ninth, tenth, eleventh, twelfth and thirteenth.

The ninth bears a lanceolate hair in every species except *A. Patersonii*; and two large, generally wrinkled hairs, one of which however in *M. grandis*, and both in *A. Patersonii*, are simple.

The tenth a lanceolate and two others, which in *L. Darwinii* and *P. Bairdii* are one wrinkled and one plumose, and in *L. Patagoniensis* and *M. grandis* one wrinkled and one simple; in *L. magna* both wrinkled, and in *A. Patersonii* both simple.

The eleventh has a lanceolate hair; a prehensile spine, which in *L. Darwinii* and *P. Bairdii* is represented by a large ringed hair; and a third which is simple in *M. grandis* and *A. Patersonii*, wanting in *P. Bairdii*, and wrinkled in the other three species. It is evident therefore, as I have remarked above, that the prehensile spine, which is large in *L. magna*, is no new organ, but merely a hair very much developed.

Finally, *the twelfth* has, like the preceding segments, a lanceolate hair, and two others which are either wrinkled or simple, or in *M. grandis* plumose.

The remaining joints are so indistinct, and it is often so difficult to determine to which the hairs belong, that I did not think it worth while to examine them as carefully. It is however evident that the hairs are arranged according to the same plan, the chief difference being, that whilst the lanceolate remain unaltered, the wrinkled and simple have been replaced by plumose hairs. The same regularity in the number, structure and arrangement of the hairs is also found on the other organs, and the more they are examined, the more does this become apparent. I hope I shall not be considered to have described the

above with unnecessary minuteness, as it was the very closeness of the agreement which struck me, and which brought before me in quite a new light the text which says, that "the very hairs of our head are all numbered." Who can help adoring that omnipotent power whose influence we perceive in everything around us, and which extends to things which we should have thought almost too insignificant for His notice!

Geographical Distribution.

The species belonging to the genus *Labidocera* have hitherto only been found in the Atlantic Ocean and in the southern hemisphere. *L. Darwinii* and *Patagoniensis* were collected by Mr. Darwin off the coast of Patagonia, Lat. 38° 40′ S. Ascending towards the Equator, at L. 18° to 22° S., and from 2° 30′ W. to 4° E., we find their places supplied by *L. magna*, *Pontella Bairdii*, and *Monops grandis*; further north again these yield to *A. Patersonii*, which is found from the north of Ireland 54° N. to 60° N., and from 6° to 25° 45′ W. Probably every part of the Atlantic is inhabited by one or two species of this group. They are all inhabitants of the open sea, and as they swim in great shoals must furnish abundant food for fishes, Medusæ, and other marine animals. All these species form, though belonging to different genera, a group characterized by having the right anterior antenna of the male swollen and provided with dentated plates, and, as far as we know at present, the Atlantic Ocean is the only part of the world in which this group occurs. Among the large number of *Calanidæ* obtained by Dana in the Pacific, and among those figured by Gaimard in the "Voyage en Scandinavie," the antennæ are only geniculated, as in the common *Cyclops vulgaris*. There are probably many species of this group as yet undescribed, but I do not know of any others at present existing in our collections.

Classification.

The presence or absence of superior and inferior eyes, and the structure of the right antenna of the male and the fifth pair of legs, whether prehensile or not, have hitherto been considered as generic characters, and upon them the classification of the family is founded. The eyes present the most useful characters; and though the antennæ and fifth pair of legs, being simple in the females, are not so convenient, yet as the species generally occur in shoals, in which the two sexes are found together, it will in most cases be found tolerably easy to make out the names. It may be doubted, however, whether these are really of generic value; for instance, *Monops grandis* and *A. Patersonii*, both of

which I have very carefully examined, have been placed in different genera, because the former has no superior eyes, and the latter has four; in all other respects, however, at least as far as regards their external anatomy, they agree very closely. The same may be said of *Labidocera Darwinii* and *P. Bairdii*. Following however in the steps of my predecessors, I was obliged to act as I have done, for if I altered their classification I was bound to propose a better, which I must confess I could not do. It seemed best, therefore, to retain an arrangement, which, if it is rather artificial, is undeniably convenient, and to delay attempting to form natural genera, until the discovery of new species, and a more intimate acquaintance with the old ones, and especially with their internal anatomy, should give more hopes of success.

Note on Anomalocera Patersonii.

For the purpose of comparing together the right male antennæ of all the species in which they are so much developed, I applied to Dr. Baird to know if he could furnish me with any specimens of *A. Patersonii*, Tem. Neither he, however, nor the British Museum, has any of Templeton's specimens, but he sent me some *Calanidæ* marked *A. Patersonii*, which have been recently brought from the North Atlantic by Dr. Sutherland. To my great surprise, however, I found that these, far from having no superior eyes, had *four*; each of the two normal eyes being divided. Considering that in this family the number of the eyes is a variable character, being sometimes one, sometimes two, and sometimes three, naturalists will not be surprised at there being also a case in which they are five in number; still it is interesting to find a Crustacean with five eyes. At first I thought this must be a new species, nay, even a new genus, for it seemed highly improbable that such accurate observers as Dr. Baird, Goodsir, and Templeton should all three have overlooked so curious a character. The structure of the fifth pair of legs, of the antennæ, the maxillæ and maxillipeds, the shape of the cephalothorax, and all the other parts in which specific differences are usually found, agreed however so closely with the corresponding organs of *A. Patersonii*, that I asked Dr. Baird to examine these five-eyed specimens, and give me his opinion on the subject. This he did with his usual kindness, and in a letter to me, he says, "I have no doubt that the specimens collected by Dr. Sutherland are the true *Anomalocera*."

The species which I have described as *Monops grandis* would have belonged to the genus *Anomalocera*; I was therefore rather doubtful whether to retain Templeton's name, alter the generic character and describe my species as a new genus; or to refer

my species to the genus *Anomalocera*, and make a new genus for the old species. Dr. Baird, however, thinks that the name ought not to be altered; it will be necessary therefore to give a new generic character.

Genus Anomalocera.

Antenna antica maris geniculans, tumida. *Oculi superiores* quatuor. *Oculus inferior* unicus. *Pes posticus maris dexter*, prehensilis.

The four superior eyes fully distinguish it from every genus hitherto described. Probably in Goodsir's and Templeton's specimens they were not so distinct as in Dr. Sutherland's. The posterior angle of the cephalothorax on the right side is much longer than that on the left. The rostrum, on the contrary, is symmetrical.

Monops agrees with *Catopia*, Dana, in the eyes, but that genus in the 'Proceedings of the Am. Ac. of Arts and Sciences' is described as follows: "Oculis superioribus nullis, inferioribus grandibus, antenna maris antica dextra geniculante; aliis Calano affinibus;....." in Calanus, and therefore in *Catopia*, the posterior feet are "non-prehensile, often obsolete;" in *Monops*, on the contrary, they are prehensile.

EXPLANATION OF PLATE VII.

Fig. 1. *Labidocera Patagoniensis*. Right antenna of the male.
Fig. 2. —— *magna*. Ditto ditto.
Fig. 3. —— *Darwinii*. Ditto ditto.
Fig. 4. *Pontella Bairdii*. Ditto ditto.
Fig. 5. *Monops grandis*. Ditto ditto.
Fig. 6. *Anomalocera Patersonii*. Ditto ditto.

XVIII.—*Notes on the Ornithology of Ceylon, collected during an eight years' residence in the Island.* By Edgar Leopold Layard, C.C.S.

[Continued from p. 107.]

32. Batrachostomus moniliger, Layard.

Only two specimens of the above new species have as yet been procured; one was caught at Avishavelly and sent to Sir J. E. Tennent, who, with his wonted kindness and liberality, transferred it to my collection. It lived three days with me, but refused all food; during the day it slept, squatting on the ground, with its head sunk between the shoulders; on being alarmed it sprang upwards with a sudden jerk, and after executing a rapid summersault in its confined cage, it would again alight and settle down like the *Caprimulgi*. I am informed this species is not uncommon in the locality from whence it was procured,

which is rocky and precipitous, and full of gullies and crevices. I also saw a drawing of one procured at Ratnapoora by Mr. Mitford of that place. He told me, he observed two of these birds, frequenting a tree in full flower, and capturing the beetles which flew about it; at last he shot one with an air gun, and the other left the place. The eyes of this species, like those of the Nocturnal Raptores, exhibit considerable luminosity, and partake of the same internal form.

33. Caprimulgus Asiaticus, Lath.,

and

34. Caprimulgus Maharattensis, Sykes. *Ra-bassa,* Cing. *Pay-marrettey,* Mal.; lit. Cheating Devil.

The last of these birds is abundant in the vicinity of Colombo, and throughout the Southern province; mingled with *C. Asiaticus,* which predominates in the North almost to its total exclusion. In habits the two species are precisely similar. Hiding during the day under the umbrageous shelter of a thick bush, the nightjars avoid the "garish eye of day," and only venture forth when twilight or the softened effulgence of the moon's rays afford it that description of light for which its vision is so admirably adapted. At these times, till morning dawns, or the moon sets (they do not venture forth during the darkness), their "churring" cry may be heard in every direction; and the belated traveller hurrying homeward ere the last dying gleams of the setting sun fade in the west, is startled by what seemed a stone flying up with a few rapid querulous notes, and gliding along on noiseless pinions settling again within a few yards of him.

During the warm rainy evenings when the white-ant hills send forth their winged hosts to propagate fresh swarms of ravagers, the *Caprimulgi* are actively engaged (assisted by the crows and bats) in thinning their numbers; their undulating motions are at these times particularly elegant and graceful, and I have watched them with delight till I could no longer distinguish them amid the darkening landscape. They never appear to fly high; in this pursuit they seldom rise beyond 15 or 20 feet; the bats thin the next rank; and above the tree-tops, evidently to have the benefit of the little remaining light, the crows eagerly pursue those ants which escape from the carnage below.

During my residence in Canada, I was surprised both by the prodigious number of "Fern Owls" which nightly made their appearance hunting in company, and also at the great altitude they attained in their airy gyrations. Here, as before stated, this is not the case, and it is a solitary bird, at most only seen in pairs.

The nest is merely a depression in the ground under a tuft of grass, or a bush, or beside a stone; the parent bird deposits two oblong eggs of a delicate buff colour, sparingly marked with irregular brown spots. Axis 14 lines, diam. 11 lines.

Dr. Kelaart procured another species at Nuwera Elia, which Mr. Blyth has described under the name of

35. Caprimulgus Kelaarti, Blyth.

I have not seen it in its native haunts.

36. Cypselus Balasiensis, Gray. *Wahæleyna,* Cing.; lit. "Rain Fowl," the name for all swifts and swallows.

Extremely common throughout the island; building in the *Borassus flabelliformis,* to the dead fronds of which it attaches its nest by some viscid secretion. The nest is a small semicircular cup composed of the downy seeds of the *Asclepias gigantea* and the *Bombax pentandrum,* which they collect on the wing. The eggs are laid in the months of June or July, from two to four in number, and pure white. The species is partially migratory.

37. Cypselus Melba, Linn.

Common about Nuwera Elia and the hilly zone; found also about Damboul and Ratnapoora.

38. Cypselus affinis, Gray.

Migratory; breeding in April in large numbers about the rocks at Damboul. I also found them building under a bridge near Tangalle in the low country. The nests, built in clusters, are composed of mud and grasses, with a small round entrance precisely resembling those of the martin, *Hirundo urbica*; the eggs from two to four in number, and purely white.

39. Macropteryx coronata, Tickell.

Generally distributed, but affecting the jungles more than the open country. It generally selects an elevated and leafless branch, from which it sallies in quest of insects; when on the wing it utters a peculiar cry resembling the words "*chiffle, chaffle,*" "*klecko, klecko,*" often repeated. Sometimes I have heard them utter the same note when at rest, rapidly elevating and depressing the crest.

I never could find the nests of this species, though the natives assure me they build in old Euphorbia trees in the jungles. It appears about Colombo in March, and disappears in December. I shot a young bird in March; its plumage was green, each

feather edged with white, causing the bird to appear as if covered with scales.

40. Collocalia brevirostris, M'Clelland.

Having fully described my acquaintance with these birds in a letter to my friend Mr. Blyth, I cannot do better than copy what I then wrote, adding his remarks and the result of my subsequent inquiries. "I have at last visited the cave in which *Collocalia nidifica* builds, and will now, with the aid of my journal, give all the information I can, sending you birds skinned and in spirit, and a young nestling taken from the nest with my own hand. The cave is situated at a place called Havissay, about thirty-five miles from the sea, and twenty from the river, and about 500 feet up a fine wood-clad hill called Diagallagoolawa, or Hoonoomoo-loocota. Its dimensions are as follows:—length between 50 and 60 feet, about 25 broad, and 20 high. It is a mass of limestone rock, which has cracked off the hill side and slipped down on to some boulders below its original position, forming a hollow triangle. There are three entrances to the cave, one at each end, and one very small in the centre. The floor consists of large boulders, covered, to the depth of 2 or 3 inches, with the droppings of the birds, old and young, and the bits of grass they bring in to fabricate their nests. The only light which penetrates the cavern from the entrances above-mentioned is very dim; when my eyes, however, got accustomed to the light, I could see many hundreds of nests glued to the side of the fallen rock, but none to the other side, or hill itself. This I attribute to the fact of the face of the main rock being evidently subject to the influence of the weather, and perhaps even to the heavy dews off the trees; but for this the side in question would have been far more convenient for the birds to have built on, as it sloped gently outward, whereas the other was much overhung and caused the birds to build their nests of an awkward shape, besides taking up more substance. I was at the spot a few days before Christmas, and fancy that must be about the time to see the nests in perfection. This is corroborated by the fact of my finding young birds in all the nests taken by me, and by what the old Chinaman* said, that the 'take' came on in October. I find that they have three different qualities of nests, and send two for your inspection; the best is very clean, white as snow and thin, and is also very expensive. The most inferior are composed of dry grasses, hair, &c., but I could not detect anything like the bloody secretion as described ('though only under peculiar circumstances of exhaustion') by Mr. Barbe, even in a fresh nest. I was in the

* Alluded to in a previous letter.

cave late (after 5 P.M.) in the evening of a day which threatened rain, but the old birds were still flying round the summit of the mountain, at a vast altitude, occasionally dashing down into the cave with food for their nestlings. By daylight next morning I was on foot, but the birds were before me, hawking on the plain below, and all about the hills: I have found the birds here in Colombo, in Kandy, and all along the road we went. I could learn nothing of the number of eggs laid, nor of their colour. I found one bird in each nest. The Chinese who live on the spot pretend not to understand anything asked them, and the apathetic Cingalese have never taken the trouble to see for themselves, so they could give me no information. The aspect of the country, broken and rugged, coupled with the numerous flocks of birds I saw flying round the various hills, lead me to think there must be many breeding places yet undiscovered. One, however, was pointed out, but we had not time to visit it. I could not hear of any other kind of *swift* breeding there, but have just received such information as leads me to suppose that *C. fuciphaga* builds near Jaffna on some rocks overhanging the sea. I may further add, that there were no bats in the cave with *C. nidifica*, nor did I see any bird of prey, save a fine *Hæmatornis*, which I shot. The Cingalese name for *C. nidifica* is *Wahalæna*."

On this letter Mr. Blyth remarks:—

"The specimens sent by Mr. Layard are perfectly identical in species with those from Darjiling, &c., and measure $4\frac{1}{2}$ to $4\frac{3}{4}$ in. long, of which the outer tail-feathers measure 2 to $2\frac{1}{4}$ in.; expanse of wings $10\frac{1}{4}$ to $10\frac{1}{2}$ in., and closed wing $4\frac{3}{8}$ to $4\frac{1}{2}$ in. The gastric glands, as in *C. fuciphaga*, present no trace of the structure figured by Sir E. Home. The nests sent differ remarkably from those of *C. fuciphaga*, in being partly composed of grass stems worked in with layers of the mucus, and one of the two has some moss fixed to the outside. Hence they correspond with the descriptions of the nest of the *Linchi* or *Lintge* of Java, or *C. fuciphaga*, the nest of which is without any such intermixture, and no doubt the misrepresentations of the gatherers have led to the mistake. As regards the activity of the birds, early and late, the requirements of the young at the particular period might sufficiently account for it, only that Capt. Lewis also found the other species with young in the Nicobars, and the habit of retiring early may prove characteristic of *C. fuciphaga**."

To this I have little to add, save that I have traced the birds up to Anarajahpoora, and doubt not they breed among the rocks in that neighbourhood. I may remark that I only found *single*

* From a paper by Mr. Blyth printed for private circulation. Calcutta, 1849.

birds in each of the nests procured by me, and that I have lately received a *single* fresh egg from Diagallagoolawa taken in the month of February. It weighed ℈ii, and was of a spotless white, slightly tapering at one end.

41. Acanthylis caudacuta, Lath.

This splendid swift is confined to Nuwera Elia. I have not seen it myself in its haunts, but received it from friends, who tell me it flies with immense rapidity, its wings causing a rushing noise as it darts through the air. The natives report that they build in hollow Rhododendron trees.

42. Hirundo gutturalis, Scop.

Common throughout the island, arriving in Colombo about the end of September.

43. Hirundo hyperythra, Layard.

I first discovered this species in November 1849 at Ambepusse, on the road to Kandy. I have since seen them at Putlam, up the Central road as far as the hills extend, at Ambegamoa, and up the Caltura river from Perth sugar estate to Ratnapoora and Adam's Peak. They breed in caverns and under bridges, and build a nest of mud attached to the roofs. The general shape and size is that of a small basin, with a round entrance hole at the top. The lining is composed of fine hay and feathers, and the eggs are laid in March. The late Dr. Gardner informed me that a pair built their nest on a ring supporting a hanging lamp, nightly used in his sitting-room. They securely hatched their eggs, unscared by the cleaning or lighting of the lamp, and the young birds returned to the nest every night for about a month after being fully fledged.

44. Hirundo domicola, Jerdon.

Found by Dr. Kelaart at Nuwera Elia breeding in the European houses. It appears to be confined to that locality; the eggs, four in number, precisely resemble those of the European species except in size.

45. Hirundo Daurica, Linn.

I found one of these birds in the village of Pt. Pedro in December: it had probably been driven over from the opposite coast by stress of weather: it was hawking about the street. I fired at, and wounded it, but it flew away. Next day it was again in the same place, and I succeeded in killing it, and I found the shot of the previous day had broken a leg.

46. Harpactes fasciatus, Lath.

This is one of the most beautiful of our indigenous birds. They inhabit the high tree-jungle called by the natives "*Mookoolaney,*" and are extremely shy. I found them about the Perth estate and Ratnapoora, frequenting the highest tree-tops. On dissection, their stomachs proved full of the remains of various insects and small seeds.

Preserved skins give but a faint idea of the beauty of these birds; the contrast afforded by the brilliant crimson breast, and the deep blue cere of the eye, bill and legs, when fresh, must be seen to be appreciated.

47. Coracias Indica, Linn. *Cawolowa,* Cing. *Kotta Killy,* Mal.; lit. Palmyra Parrot (from breeding in hollow palmyra trees).

Common, and widely distributed; very partial to the small clumps of trees scattered over the cultivated parts of the Jaffna peninsula; they are also very fond of sitting on the top of the Well-Whips in the fields. It breeds in hollow trees, laying four or five greenish eggs profusely speckled with dark brown spots. Axis 15 lines; diam. 11 lines.

48. Eurystomus orientalis, Linn.

Very rare in Ceylon; but three specimens fell under my notice; one I killed in the Pasdoom Corle. It resembled the preceding in its flight, but clung to trees in the manner of the *Picidæ.* I shot it in the act of tearing away the decayed wood round a hole in a dead tree. The other birds I killed at Gillymally in a similar situation. Their stomachs were full of wood-boring coleoptera, swallowed whole, and merely a little crushed, and I saw them beat their food against the trees as a thrush would beat a snail.

49. Halcyon capensis, Linn.

Is rare in the immediate neighbourhood of Colombo, but found occasionally about Caltura, and up the river to Ratnapoora. It is very abundant near Trincomalee and Batticaloa, and the Anarajahpoora Wanny, frequenting tanks, and feeding on fish, frogs, crabs, and small mollusca. When flying they utter a loud harsh note, not unlike the cracking of castanets. I have never obtained their nests, but the natives say they build in hollow trees.

50. Halcyon atricapillus, Lath.

This lovely kingfisher has but once fallen under my notice as

an inhabitant of Ceylon. The specimen in question was shot in the Jaffna district, in the island of Valenny. I know nothing personally of its habits.

51. Halcyon Smyrnensis, Linn. *Calavy cooroovi*, Mal.; lit. Large-mouthed Bird.

Very common and widely distributed, feeding indiscriminately on fresh or saltwater fish, crabs, beetles, and butterflies. I have seen them capture these last in the manner of flycatchers (*Muscicapidæ*), darting from a sprig and seizing them in the air, their mandibles closing with a snap, audible at the distance of some yards. One, which was unluckily introduced into an aviary, destroyed most of the lesser captives ere he was detected as the culprit; he was at last caught in the act of seizing a small bird in his powerful bill; he beat it for a moment against his perch, and then swallowed it whole. The nest of this species is found in decaying trees; the parent bird deposits two white eggs, axis 15 lines, diam. 13 lines, beautifully smooth and shining. I have procured eggs in the north of the island in *December*, in the south in *April*.

52. Ceyx tridactyla, Linn.

This lovely little bird is certainly one of our uncommon species, and yet, at the same time, widely distributed. I have seen it at Galle, Trincomalee, Anarajahpoora, Matelle, Putlam, and Ratnapoora. It delights equally in the headlong waters of the mountain torrent, and the calm unruffled bosom of the jungle tank; and glancing like a gemmed arrow past the traveller journeying along the narrow native road, its minute form evades his quickest shot. I have only procured one specimen.

53. Alcedo Bengalensis, Gmel. *Mal-pillihudua**, Cing.; lit. Flower Kingfisher.

Found throughout the island, feeding alike on small fresh or saltwater fish, crustaceans, &c. It is captured in great abundance during some seasons of the year, by Moormen who resort to this country for that purpose, and transmit the skins to China, where they are used for embellishing fans and other fancy work. They are entrapped by a net placed under the water covered with horse-hair nooses, and baited with a small fish.

54. Ceryle rudis, Linn.

Commonly distributed, feeding on fresh or saltwater fish, accordiug to its locality. Whilst other kingfishers pounce upon their

* *Pillihudua* is the native name for all Kingfishers.

prey from the overhanging bough of a tree, or solitary stake protruding from the water, *C. rudis* hovering in the air with head inclined marks its victim. Plunging down with unerring aim, it is lost for a moment in the spray caused by its heavy fall, and reappears with the prey struggling in its bill.

55. Merops Philippinus, Linn. *Kattalan cooroovi*, Mal.; lit. *Aloe* Bird (from a fanciful resemblance in the tail of the bird to the aloe plant). *Pappugai de champ*, Port.; lit. Ground Parrot.

This bee-eater is very common throughout the island during the period of its visitation: it is the harbinger of the snipe, and appears about the middle of September.

They frequent open fields, perching on fences, or on the tops of low bushes, always choosing a dry projecting twig, from which they dart at any insect that may pass by, returning with an elegant sailing flight: before the prey is devoured, they beat it against the perch till sufficiently broken to be swallowed entire. In the evenings they frequently pursue insects after the manner of swallows, uttering the while a pleasing chiruping note and soaring to a great height in the air.

56. Merops viridis, Linn.

This species is confined to the open plains of the maritime districts. I have seen it at Trincomalee and Hambantotte, and traced it from Chilau to Mulletivoe. I am not aware that it is found near Colombo, nor in the interior, where the preceding and following species replace it.

It delights in the neighbourhood of water, over which it hunts for insects. I have even seen it take them from off the surface, which it has struck with its breast in the endeavour. It is a much bolder bird than either of the other two, often allowing a European to approach within a few feet before seeking its safety in flight.

It is singular to observe the distinction in this respect between the native, in his usual state of semi-nudity, and the white man; the former can usually approach closely to any wild animal or bird, but the sight of the latter puts them to speedy flight: I attribute this more to the colour of the face than to the European dress; for I always found that by allowing my beard and whiskers to grow, I could approach them more closely than when shaved.

M. viridis roosts in large flocks, always returning to the same tree for successive months; they usually retire before 5 o'clock in the evening, whereas *M. Philippinus* flies till dark.

57. Merops quinticolor, Vieill.

Whilst the two former species frequent low open plains, and are rarely, if ever, seen in elevated districts, the present species, on the contrary, affects the hilly forest region. Here it pursues its insect prey among the lofty tree-tops, seldom descending to the ground, except in the breeding season, when it frequents steep banks for the purpose of providing a suitable habitation for its young: this is generally effected by scooping a hole in the soil, to the depth of about 18 inches, terminating in a domed chamber, in which the young are hatched on the bare ground. The eggs, two in number, resemble those of the kingfisher in shape and colour: they are hatched in April.

58. Upupa Senegalensis, Swain. *Chaval cooroovi*, Mal.; lit. Cock Bird (from their crest).

The hoopoe is common in the Jaffna peninsula during the season of its stay, and I have every reason to believe that it not unfrequently breeds with us, as I shot young birds not fully fledged, in August. I saw the bird at Hambantotte and Trincomalee, and procured one solitary specimen in Colombo.

They feed much upon the ground, and are indefatigable in scratching into the ordure of cattle, in search of small coleoptera: at such times the crest is carried flat on the head; but when seated on a tree-top uttering its monotonous "*hoop, hoop, hoōp,*" the crest is rapidly elevated and depressed, the bird swinging itself backwards and forwards at every repetition of its note.

I have been assured by a gentleman long resident in the Northern Province, that *U. Epops*, Linn., had occurred to him; sed non vidi.

59. Nectarinia Zeylonica, Linn. *Teyn cooroovi*, Mal.; lit. Honey Bird.

My house in Colombo was, as is usual in the East, surrounded by a verandah, up which crept, in tropical profusion, several species of *Passiflora*; to the flowers of these came the various *Nectariniæ* for their morning and evening meals, rarely appearing in the heat of the day; they hovered about the starry flowers, thrusting in their curved bills, in search of the minute insects on which they fed; occasionally they would fly into the verandah and seize a small spider from its web, or from the crevices of the walls. Then they would betake themselves to the trellis supporting the passion-flowers, or to the branches of a pomegranate close by, where they pruned themselves and uttered a pleasing song. If two happened to come to the same flower, and from their numbers this often occurred, a battle always ensued, which

ended in the vanquished bird retreating from the spot with shrill piping cries, while the conqueror would take up his position upon a flower or stem, and swinging his little body to and fro, till his coat of burnished steel gleamed and glistened in the sun, pour out his note of triumph. All this time the wings were expanded and closed alternately, every jerk of the body in *N. Asiatica* and *N. Lotenia* disclosing the brilliant yellow plumelets on either side of the breast.

N. Zeylonica is abundant in the southern and midland districts, but is rare in the north, where it is replaced by

60. Nectarinia minima, Sykes.

I never could ascertain to my satisfaction the nest of these species, but believe them to be similar to those of the following.

61. Nectarinia Lotenia, Linn.

This species is exceedingly plentiful in the southern and midland districts; it is not so common in the north as

62. Nectarinia Asiatica.

The nests of these latter two are elegant domed structures, generally suspended from the extremity of a twig of some low bush artfully covered with cobweb, in which I have often seen the spider still weaving her toils, having extended the web to the surrounding branches, thus rendering the deception still more effective; and it would seem that the birds were aware of it and left their helper undisturbed.

The entrance to the nest, which, if built in a bush, is always turned inwards, is screened from the sun and rain by a portico projecting often above an inch beyond the walls. The eggs usually are from two to four, of a whitish ground colour, so closely speckled with minute dusky spots as to appear gray. They weigh from ℈i. gr. 1. to ℈i. gr. 6, while the parent bird is only ʒii. heavier. The young males are clad in the livery of the female, but at the first moult assume their proper garb, the brilliant metallic hues first appearing in a long line down the breast.

63. Dicæum Tickelli, Blyth.

This, the smallest of our feathered tribes, is plentiful among parasitic plants wherever found, but it especially delights to feed on the white viscid berries of a misletoe? which flourishes on the Sooria (*Hibiscus*) trees, and I believe it is by their means that the plant is propagated, the seeds passing undigested

through the intestine. I never saw the nest of this species, nor do the natives seem cognisant of it.

64. Phyllornis Malabarica, Lath.

A rare species, and confined to the upland districts. Dr. Kelaart procured it at Nuwera Elia, and Muttoo brought in a single specimen whilst I lay ill at Gillymally.

65. Phyllornis Jerdoni, Blyth.

Extremely common in the south of Ceylon, but rare towards the north. It feeds in small flocks on seeds and insects, and builds an open cup-shaped nest. The eggs, four in number, are white, thickly mottled at the obtuse end with purplish spots.

66. Phyllornis aurifrons, Temm. ?

Included by Dr. Kelaart in his catalogue; sed non vidi.

67. Dendrophila frontalis, Horsf.

This elegant little creeper is abundant about jack-trees, among the branches of which it incessantly creeps in search of minute insects, examining the under as well as the upper sides, and the bold little climber courses upright or headlong with equal facility.

These birds always hunt in small parties, and the rapidity of their motions is such as to baffle the eye.

[To be continued.]

XIX.—*On the Head of the Genus* Conus, *Linn.*

By J. E. Gray, Ph.D., F.R.S., V.P.Z.S. &c.

Adanson (Voy. Seneg. t. 6), Lesson (Voy. Freycinet, t. 67. f. 7), Quoy and Gaimard (Voy. Astrolabe, t. 52 & 83), Philippi (Moll. Sicil. t. 12. f. 19), Ehrenberg (Sym. Phys. t. 2), Eydoux and Souleyet (Voy. Bonite, t. 45), and Chiaje (Moll. Sicil. iii. t. 45), have described and figured the animal of the Cones as having an elongated muzzle or rostrum like the phytophagous univalve mollusks; and Lovèn, probably misled by these descriptions, expressly describes them as having "*rostrum productum non recondendum.*"

Never having had an opportunity of examining the mouth of these animals before the publication of the arrangement of the families which I proposed in the 'Annals and Magazine of Natural History' for Feb. 1853 (xi. 130), I placed the family *Conidæ* in the suborder *Rostrifera*.

Having lately, in pursuing my researches on the teeth of Mollusca, examined the mouth of several species of Cones, I was surprised to find that they were all provided with a distinct retractile proboscis, and that the part which had been mistaken for the rostrum was only a prolongation of the veil which unites the base of the tentacles, always found in the *Proboscidifera*, but which in this genus is more developed, and assumes the semblance of a rostrum. This is the more remarkable, as Adanson specially describes the mouth of the rostrum as round and contracted, and some authors figure it as linear and inferior.

The veil in all the species I have examined is produced somewhat like a muzzle or rostrum, and is provided with a large aperture, which, when contracted in spirits, is oblong, transverse, and has a more or less large longitudinal slit on the centre of the upper surface, as is well represented in De Blainville's figure of the animal (Freycinet, Voy. t. 67. f. 7, copied by Mrs. Gray, Mollusca, t. 11. f. 8); but from the appearance of the animal when it has been placed in a weak solution of caustic potass, I believe that it is funnel-shaped and expanded at the end when the animal is alive; and Adanson particularly observes that the Cones use the mouth, as he calls the end of the veil, as a leech does its oral disk, to attach itself to any animal it touches.

In most specimens the veil is simple on the edge, but in others, as *Conus Tulipa* and *C. striatus*, it is fringed with a series of cylindrical beards or tentacles, as represented by Quoy and Gaimard (Voy. Astrol. t. 53. f. 2 & 12, copied by Mrs. Gray, Mollusca, t. 12. f. 2 & t. 10. f. 6).

The proboscis in its retracted state, as seen in the animal preserved in spirits, is short, broad, conical, annulate, prominent, in the base of the tubular veil, with a roundish central mouth. Instead of having any elongated lingual band covered with short transparent teeth, like the rest of the *Proboscidifera* and *Rostrifera*, it has a fleshy tube with a bundle of subulate barbed teeth directed towards the mouth; this tube is prolonged behind and below at right angles with its upper part and mouth into an elongated, fleshy, attenuated subulate tube, containing with its hinder edge two series of similar subulate red barbed teeth directed from the aperture towards the apex of the tube.

The teeth are implanted by a distinct root into the substance of the tube; those near the upper or oral part of the tube are placed rather irregularly in two parallel rows, but those nearer the tip are more crowded, and the lines gradually diverge from each other.

I shall not attempt to describe the manner in which these teeth are brought into action, as I have only seen them in the preserved specimen; but those nearest the mouth are probably

used to pierce the animal, which is held fast by the contraction of the veil as described by Adanson. The organization and structure of the mouth are so unlike that of the other *Proboscidifera* and *Rostrifera*, where the teeth are placed on a lingual band and used to rasp the food, being replaced by others as those in action are injured by use, that I am inclined to form the *Cones* into a third suborder, which may be called *Toxifera*; and it is probable that the *Pleurotomidæ*, which are described by Lovèn as having similar subulate teeth in two series, should be placed in the same suborder, as they appear to differ from the Cones chiefly in the veil being truncated and not produced round the base of the proboscis,—a character of comparatively little importance, as the *Dolia*, and probably the *Cassides*, and some species of *Tritons*, have the veil more or less produced, forming a more or less distinct tube round the base of the proboscis, and giving the appearance of having a very short rostrum.

While on the subject, I may observe that the genera *Cassidulus*, *Cochlidium*, and I believe *Fulgur*, have the head produced into an elongated cone like a rostrum; but in these the tentacles, which are generally very small, are placed at the top of the cone on the side of the small apex, from which the very long retractile proboscis is emitted, as in the normal *Proboscidifera*. I am inclined, on account of this peculiarity in the form of the head, to separate these genera from *Muricidæ* and form for them the family *Cassidulidæ*.

I sent this communication in manuscript to Mr. Arthur Adams, that he might have the opportunity of placing the family *Conidæ* in its proper position in the forthcoming number of his 'Genera of Mollusca,' and he informs me that he has observed the veil of the genus expanded in the living animal, and referred me to the following observations made by him on the habits of these animals, showing that the theory I had ventured to propose is correct:—

"Its bite produces a venomed wound, accompanied by acute pain, and making a small deep triangular mark, which is succeeded by a watery vesicle. At the little island of Mayo, one of the Moluccas near Ternate, Sir Edward Belcher was bitten by one of the Cones, which suddenly exserted its proboscis as he took it out of the water with his hand, and he compared the pain he experienced to that produced by the burning of phosphorus under the skin..... The instrument which inflicted the wound in this instance was probably the tongue, which in these mollusks is long and armed with two ranges of sharp-pointed teeth." (Zool. Voy. Samarang, 19.) Mr. Adams informs me that it adhered to the hand by its mouth like a leech, as described by Adanson.

XX.—*On the Animal of* Rotella, *Lamk.* By J. E. Gray, Ph.D., F.R.S., V.P.Z.S. &c.

This animal has great affinity with that of the *Trochidæ*, but differs so widely in some important particulars that it appears worthy of a separate description, more especially as the figures of the animal of this genus given by Quoy and Gaimard (Voy. Astrolabe = Gray Mollusca, t. 38. f. 7, 8, and by Kiener, Conch. t. 1 = Gray Mollusca, t. 107. f. 6) do not properly represent the animal: both must evidently have been taken from a species of *Trochus*.

The foot is truncated in front, and when contracted in spirits has a deep central groove, and the side edges folded down in front. The lateral fringe is distinct, with three tentacles on each side; on the front of the right side near the base of the tentacles it is produced into an oblong fleshy lobe, which probably partly covers the base of the shell when the animal is exposed, and may deposit the peculiar callosity over the axis which characterizes the genus. The upper part of the body has a deep groove on each side separating it from the rest of the body. The tentacles two, subulate, with a black longitudinal central line; the right tentacle is largest and free, with an oblong compressed lobe on its hinder side, which has an indistinct indication of an eye on the inner part of its upper edge; hence I am inclined to consider it as a modified eye-pedicel. The left tentacle is smaller and partly attached to the upper side of the left eye-pedicel, which is cylindrical, bearing a very distinct eye, and with a large membranaceous expansion attached to the whole length of its left side, which is fringed with small black beards or tentacles on its edge; this expansion is folded first over the mouth towards the right tentacle, and then folded back to the left side of the head and continued by a slightly elevated ridge to the front edge of the left lateral fringe, being a modification of the appendages near the base of the tentacles found in other *Trochidæ*. There is no muzzle, as in the animal of that family, but a small circular sunken hole under the base of the fringe veil emitting a short cylindrical retractile proboscis, armed with an elongated linear lingual membrane. The teeth, as figured by Lovèn, are, as in the *Trochidæ*, placed in many oblique ridges on each side of the lingual membrane; they are subulate, suddenly bent at the end, and finely denticulated near the tip; the innermost series is compressed and suddenly dilated from just under the bend. The operculum is orbicular, horny, thin, of many gradually enlarging whorls, finely ciliated on the outer edge, and rather concave externally.

Since I examined the animal and made the above description,

I have received the May number of the 'Annals of the Lyceum of New York' (vi. 35), containing a figure and description of the animal of *Rotella* made by the Rev. S. B. Fairbank of Bombay, and transmitted by him to the late Professor C. B. Adams.

Mr. Fairbank describes the lobe on the right side of the body, which is an extension of the front end of the lateral fringe, as a lobe probably "of the mantle which partly clings to the shell, but does not at all envelope it;" and he calls the veil "a siphon," and describes it "as a tube, the side being slit next the outer lip of the shell and filled with cilia; the cilia are tipped with black; sometimes they gather against the sides, so that you see the tube with a black rim, but usually they are disposed much as I have dotted them in the figure," that is to say, like the rays of a star. The lateral fringe, so constant in all the *Trochidæ*, is entirely overlooked in this figure and description. He observes that these shells are found where the water would leave them dry at least two hours each tide, just buried in the sand; when placed in water, they did not move about much, but only raised their siphons. As represented in the figure, the "siphon" greatly resembles the fringed siphonal tube of a bivalve shell; but I can scarcely conceive that the veil, as I observed it in the animal in spirit, could form such a complete tube. The part here called a siphon can only be considered as a great development of one of the fringed lobes which are found near the base of the tentacles of most *Trochidæ* and *Turbonidæ*, and which is a continuation over the head of the lateral membranes of these animals. It differs chiefly from the other *Trochidæ* in the rostrum not being developed, and the mouth consisting of a round opening under the base of the veil, and in the peculiar development of the frontal appendages.

XXI.—*On the Phosphorescence of some Marine Invertebrata.* By M. A. De Quatrefages*.

[Concluded from p. 27.]

Second Part.—*General Observations on Phosphorescence.*

1. *Description of the Phænomenon.*—It would be useless to repeat here all the details given by travellers; I will confine myself to some remarks on my own observations.

The phosphorescence of the sea has appeared to me under two different forms:—1st, a result of scintillations more or less nu-

* From the Annales des Sciences Naturelles, vol. liv. 3rd series, as inserted in Silliman's American Journal of Science for July, 1853.

merous, always isolated, and not giving at all the idea of a liquid in itself luminous; 2nd, a general glow more or less uniform, the phosphorescent substance seeming to be dissolved in the water itself.

In both cases phosphorescence is equally a result from living animals directly emitting the light, but the species which produce the phænomenon are different.

A. I have often observed the first mode of phosphorescence on the western coasts of France, at points peculiarly exposed to the action of currents and waves. At Chausey, especially in the small channel called "le Sund de Chausey," I have seen very numerous and brilliant sparks brought out by each stroke of the oar. The track of the vessel seemed for a moment as if strewn with diamonds, but these sparks, always very brilliant, and appearing at the same instant, never communicated a general glow to the water. They remained completely isolated, and were distinct from the dark surface of the sea. At Brehat, St. Malo, and St. Vaast, I observed similar facts. The fishermen whom I questioned, all assured me that in these regions, the sea never presented a different appearance; the young men who had never left their native coasts, did not seem to understand my inquiries relative to a more general or diffused phosphorescence. M. Beautemps-Beaupré mentions his observing phosphorescence of this kind during one of the numerous excursions in which he was engaged, while making his magnificent Atlas of the coasts of France; but he cannot recall the exact locality. It was in the neighbourhood of St. Brieuc, and it may be that this single observation was made in some well-sheltered harbour, like the port of Paimpol.

If the sea itself rarely presents any remarkable phosphorescence in the localities of which I am about to speak, it is not so with the marine plants which are left by the tide. In some circumstances I have seen masses of the Fucus kindle up when seized a little rudely; but even then the light was in isolated points, which the eye easily distinguished from one another. In no case did the stalks or the leaves present the uniform tint of a metal at a white heat, and the water which ran out freely was never luminous. Moreover, the part of the beach which the sea had just left dry remained perfectly dark. At most, only a few sparks might be seen over a space of some extent.

Water drawn from the sea in the circumstances of which I speak, and when the scintillations were most numerous and most brilliant, often became suddenly obscure, or presented only some few luminous points, when the vase containing it was violently shaken, and these ordinarily disappeared instantly. This same water, poured out from some height, presented nothing peculiar.

Never, in the regions of which I speak, have I seen the waves breaking on a shore presenting the appearance described by travellers.

B. The second kind of phosphorescence I saw for the first time near Stromboli. Here the effects of the light were heightened by the dark hue of the waves around the volcanic cone; moreover, at Boulogne, and probably at Havre, Dieppe, Ostend, &c., this phænomenon is as complete and interesting as at Stromboli.

At Boulogne, the phosphorescence is apparent throughout the harbour, except where the waters of the Liane flow into it. It is diminished and perhaps destroyed towards the entrance, between the two dykes. It is very decided through the whole port properly so called, in the basin, and especially in the little cove named the "Parc aux huitres." The last locality, being very accessible, afforded opportunity for studying all the details of the phænomenon.

However favourable the circumstances for observation, the water when quiet was always perfectly dark; but the least movement drew forth light. A grain of sand cast upon the dark surface produced a luminous spot, and the undulations of the water were so many bright circles. A stone as large as the fist produced the same results in a more intense degree, and moreover each splashing occasioned a scintillation like that of a bar of iron at a white heat when struck upon an anvil. The entrance of a steamboat when the phænomenon was most apparent, was a magnificent sight, and recalled to mind the descriptions of travellers.

The "Parc aux huitres" was always bordered by a phosphorescent girdle, resulting from the incessant undulations of the sea, which reached the shore under the form of small waves; but in perfectly fair weather this light was too feeble to be distinguished at a distance. When these undulations were only 3 to 4 inches high, the ring might easily be seen from the pier, throughout its whole extent, and was especially marked in the inner part of this little harbour.

At Boulogne, as at Stromboli, these luminous waves, seen from a distance, presented a uniform tint of a pale dull white. It might be called almost a froth, resulting from the action of the waves against the shore; and seen at mid-day under the most favourable circumstances, that was all I could distinguish at a distance of seventy to eighty yards. In proportion as you advance the appearance changes; the waves, as they near the shore, seem crowned with a light bluish flame, which M. Becquerel has justly compared to that of a bowl of punch. When they strike, this brightness becomes whiter and more vivid. On reaching the bank, you often see these same waves under the aspect of

surges of melted lead or silver, strewn with an infinite number of bright scintillations, either brilliant white, or of a greenish tinge. The spectacle is then most beautiful, and after having witnessed it on a small scale, I understood the impression left on the minds of travellers who have seen it under the tropics, in all its magnificence. The following are the facts which I have myself witnessed.

The waves, in breaking on the nearly horizontal beach of the cove, although so little elevated, covered quite an extent, and the whole space presented a uniform and glowing tint, from which started out innumerable scintillations yet more brilliant, and of a bluish or greenish hue.

As the water became absorbed by the sand, a line more strongly luminous indicated its limit. This effect was especially marked in the little cavities which the shore presented, where the line formed concentric curves which diminished as these little basins were exhausted. On passing a long stick rapidly in the water, it presented in its whole length the appearance of a blade of silver.

The water taken up at random and poured out from a little height had exactly the appearance of melted silver, and it was the same in the slightest spray. It left upon the hands or clothes bright spots that were quite persistent. At one time, when, on a short excursion with M. Bouchard, a dog ran barking at us, we threw at him the contents of a small cup, and he fled in terror from what he seemed to take for fire, and troubled us no longer save at a distance. If we plunged our hands into the sea, when drawn out they were luminous all over, but after a few seconds they were marked only here and there with bright spots, whose brilliancy remained constant and without scintillations.

The bank recently left by the tide did not however show any trace of phosphorescence; yet at the least shock it became luminous, and seemed literally to glow under the steps of the observer. In some circumstances, wherever the foot rested on the sand or gravel, it seemed like burning coals beneath the tread; and this appearance was equally perfect, with more or less brilliancy, even to a distance of some inches.

The *Talitri*, so numerous on our sandy shores, and whose habits have gained for them from the fishers the name of sand-flea, become luminous by contact with the phosphorescent water, —a fact to be noted; for at first one might be led to imagine that they were the cause of the light. Nothing can be more curious than to see these sand-fleas leaping by hundreds, and appearing like the scattering of tiny sparks.

2. *The Animals that produce the phosphorescence in the two preceding cases.—a.* At Chausey, Brehat, St. Malo, and Saint Vaast,

I have many times sought for the cause of the bright sparks which I saw shining and then vanishing in darkness. In each case I met with living animals, and these animals were always Crustacea, Ophiura or Annelida. I usually found the first in the water drawn up either from channels or at some distance from the shore. The second were under stones, or in the masses of seaweed. It was especially to the Annelida that the Fucus owed its brilliancy.

These results explained all the circumstances of the first kind of phosphorescence. The Crustacea, whose movements are energetic and whose locomotion is extended, cannot easily be collected in sufficient quantity on a given point to have their scintillations appear like a uniform tint. Besides, there is nothing in the habits of the species I have examined to lead one to suppose that they are inclined to collect in numerous bands. The size of the *Ophiura* prevents such an idea with regard to them; and the smaller Annelid for a like reason cannot contribute to such a result. Thus the light produced by these different animals is always seen in points more or less near each other, but never really blended.

b. At Boulogne, on the contrary, we find this brilliant light exclusively due to *Noctilucæ*. With the most careful examination, I have never found in my vases a single Annelid, or a single phosphorescent Crustacean.

Many circumstances, some of which will be explained hereafter, illustrate the particular mode of phosphorescence of the sea, rendered luminous by the presence of these Rhizopodes. We will first notice their size and great number. The diameter of these *Noctilucæ* varies from about $\frac{1}{3}$th to $\frac{1}{3}$rd of a millimetre; but their abundance more than compensates for their minuteness, each drop of water, as observed by Suriray and M. Verhaeghe, containing one or more. The following calculations will give some idea of their vast numbers.

In taking up some water at random from a brilliant wave, I filled a tube about a decimetre in height. After being left a little time quiet, the deposition of *Noctilucæ* on the surface of the liquid was about $1\frac{1}{2}$ centimetre in thickness. Thus the *Noctilucæ* composed about $\frac{1}{7}$th of the phosphorescent water. Again, I took the water from the surface and filled a vessel about one-half. The whole height of the liquid was about 15 centimetres, and that of the mass of *Noctilucæ* was about 5 centimetres; here the proportion was about $\frac{1}{3}$. Finally, I remember that at False Bay, M. de Tessan found the proportion equal to $\frac{1}{2}$. From these numbers, it is easy to understand how the sea, rendered luminous by the *Noctilucæ*, may present a uniform brilliancy, irresistibly impressing the idea of a phosphorescent solution. When the

surface of the sea is tranquil, as in a well-protected harbour, the *Noctilucæ*, because of their small specific gravity, form a continuous bed, and the least movement is sufficient to cover that dark surface with a brilliant mantle. When the movement of a vessel at once breaks in upon this mass of *Noctilucæ*, and also calls out their simultaneous phosphorescence, the myriads of bright points lying in the trough of the wave present one universal hue. From a distance, the eye sees throughout a uniform brilliancy, and near by distinguishes only the most brilliant scintillations, or those thrown out by the animals at the immediate surface of the water. These brilliant waves are like so many nebulæ resolved by the eye only in part.

THIRD PART.—*Observations and Experiments on the Light of the* Noctilucæ.

[Instead of giving a full translation of this Part of the memoir, as has been done of the preceding, we offer here an abstract presenting in brief the conclusions of the author.—EDS.]

1. *In a sea rendered phosphorescent by* Noctilucæ, *the light proceeds only from the body of these Animals.*—This proposition is proved by direct microscopic examination; and by the water's being deprived of all light when the *Noctilucæ* are filtered out, and becoming luminous again when they are restored to it. In a tube of the seawater, the *Noctilucæ*, if left quiet, soon form a layer at the top of the liquid, and the light is confined entirely to this layer of the animals.

2. *The production of light is independent of contact with the air.*—The flashes of light that are produced with the breaking of every wave might seem to show that the access of the animals to the external atmosphere was essential to the result. But on the contrary, it is found by observation that in a vase of seawater containing the *Noctilucæ*, the bed of these animals that collects at the top of the base is equally luminous in every part.

3. *Colour of the light.*—When the *Noctilucæ* are in full vigour of life in quiet water, the colour is a clear blue. But on agitating the water, or in the waves of the sea, the light becomes nearly or quite white, or like silver sprinkled with some greenish or bluish spangles.

4. *Intensity of the light.*—M. de Tessan states that in some tropical seas, the phosphorescence is so bright from the breaking waves, that he could read ordinary type at a distance of fifteen paces. The light from the *Noctilucæ* cannot compare with this. At the head of the cove of the "Parc aux Huîtres" at Boulogne, it was not possible to tell the hour with a watch when the waves were breaking at the observer's feet. With a tube 15 millimetres

in diameter, in which the *Noctilucæ* formed a bed at the surface nearly 20 millims. thick, the figures of a watch face could be read; but strong agitation of the tube was necessary, and it was requisite to hold it close to the glass of the watch. Four to five teaspoonsfull of *Noctilucæ* were collected in a filter, and on producing the phosphorescence by this means the hour could be told at the distance of a foot.

5. *No disengagement of heat sensible to a thermometer accompanies the phosphorescence.*—This fact was established by placing the bulb of a thermometer in the Noctiluca water while it was quiet, and then giving it a shake to produce the phosphorescence. The experiment was varied in different ways.

6. *The light of the* Noctilucæ *may be produced over the whole surface of its body or only a part of it.*—After a violent agitation, the *Noctilucæ* retain the phosphorescence for some time, so that it may be studied at leisure. With a lens magnifying 6 to 8 diameters, it is easy to see that while some of the *Noctilucæ* are phosphorescent throughout, others are but partially so. In the figure Pl. VI. (fig. 7), one of the animals is light over its whole surface, and the other (fig. 8) only on opposite sides. With a lens of 10 to 12 diameters we find that the light often appears successively on different parts of the body. There is hence no circumscribed phosphorescent organ, as in the Lampyri, Elaters, and Pyrosomas*.

7. *The light is due to an infinite number of minute scintillations.*—Figure 9 of a part of a *Noctiluca* much magnified, represents the actual character of the phosphorescence. There is an immense number of points of light. With a lens of 20 to 30 diameters, the light is like an undefined nebula; but with a lens of 60 diameters it is partially resolved, and with 150 diameters, wholly, into its constituent spangles. Each luminous spot on the body is found to consist of a cluster of minute instantaneous scintillations, dense at the centre, and more scattered towards the circumference of the spot. Thus the same phænomena take place in the *Noctilucæ* as were observed by M. de Quatrefages in the *Ophiuræ* and *Annelida*. Each spot of light is resolvable into constituent points, and consists of evanescent scintillations.

* The *Noctiluca* (Pl. VI. fig. 6) has a depression on one side, and near the middle of this depression is the mouth. At the same place there is a moveable appendage as long as half the diameter of the animal. The body is perfectly transparent. The general envelope consists of two membranes distinguished with difficulty. The outer is excessively thin and like an epidermis; the inner is thicker, but without a trace of fibres. On compression the envelope acts like a bag full of liquid, and finally bursts. Numerous anastomosing and branching lines radiate from the mouth through the granulous interior.

8. *The light from the dead* Noctilucæ, *or from fragments of them, is identical with that from the vigorous living animal.*—When the light of the *Noctilucæ*, after frequent excitement, becomes white, it is also more fixed, and finally covers the whole body. From numerous experiments, M. de Quatrefages concludes, that this kind of light is evidence of disease, or of a decline of vigour, and when the light is universal, of death. Microscopic examinations make it apparent that in these cases the light is still made up of minute points, and it is evidently of the same nature with the light given out in active life.

9. *Precautions necessary to succeed in the preceding observations.*—The animals should be examined without the use of a compressor; and care should be taken in employing high powers, not to be deceived by the light proceeding from a point not quite in the focus, whose rays produce a confused image, as if the light were uniform instead of localized. This illusion is difficult to avoid with fragments, as they are apt to be folded, so as to bring more than one point of light in the focus at once.

10. *The phosphorescence is not the result of a kind of combustion.*—On taking a barometer tube nearly filled with mercury, putting in some seawater containing *Noctilucæ* (the water occupied 6 centimetres of the tube, and the bed of *Noctilucæ* was 3 centimetres thick), and then inverting it over mercury, a phosphorescence was produced of the pale white light which indicated approaching death, a consequence of the imperfect vacuum. After one hour and eighteen minutes, the phosphorescence had ceased, and could not be restored by shaking it. Oxygen gas was introduced without effect. It is probable that the phosphorescence, if due to combustion, would have been restored by the oxygen, as happens with the Lampyri, according to Matteucci, under similar circumstances.

Four tubes were filled with water containing the *Noctilucæ*. Into one oxygen was poured, into the second hydrogen, the third carbonic acid, the fourth chlorine. The first three gases produced the same effect, and not more than atmospheric air occasions through the agitation its passage causes. After half an hour these tubes were shaken with precisely the same result in all. Chlorine acted like other irritating agents; the light was at first bright and continuous, but rapidly became extinguished. Macaire and Matteucci have shown that the light of the Lampyri is immediately brightened in oxygen, and rapidly extinguished by carbonic acid. The light therefore cannot be alike in origin in the two cases.

11. *All physical agents that produce contractions cause phosphorescence, and in proportion to the intensity of the contractions.*—This conclusion was established by M. de Quatrefages by ex-

periments upon the influence of pressure, heat and electricity; of sulphuric, nitric, muriatic and hydrosulphuric acids; potash, ammonia, alcohol, æther, turpentine, common salt, Owen's liquid, milk, fresh water. With very dilute sulphuric acid, the excitation is strongly marked, attended with a rupture more or less rapid of the filaments uniting the interior mass to the envelope, and finally a detachment of the mass from the envelope, and a withdrawal towards its mouth. A portion of the inner mass and tissues may still cover the inner surface of the envelope; but after a while they come away from the envelope, and collect about the mouth, leaving the envelope empty. In the dark there is a very brilliant light at the first contact of the dilute acid with the *Noctilucæ*; then afterwards there appears a clear fixed white light on one part, which rapidly spreads, till the whole is like a ball of silver. The brilliancy soon after begins to diminish, and rather rapidly disappears. The rupture of the fibres and disorganization of the interior mass evidently take place consentaneously with the flashes and change in the light.

It is hardly necessary to cite the other experiments in this place. M. de Quatrefages concludes that the light is produced by the contraction of the interior mass of the body; that the scintillations are owing to the rupture and rapid contraction of the filaments of the interior, and that the fixed light which these animals emit before dying, proceeds from the permanent contraction of the contractile tissues adhering to the inner surface of the general envelope. The production of the light is independent of all material secretions. Whether it is accompanied by a discharge of electricity or not remains to be ascertained.

XXII.—*On some new Carboniferous Limestone Fossils.* By Frederick M'Coy, F.G.S., Hon. F.C.P.S., Professor of Mineralogy and Geology in the Queen's University of Ireland.

Pinna spatula (M'Coy).

Desc. Valves very narrow and much elongated, about four times larger than the width of posterior end, very slightly convex except at the beaks, which are pointed and almost cylindrical, the sides gradually flattening as they approach the posterior end, which is subtruncate or slightly rounded obliquely; cardinal margin slightly thickened, with the cartilage ridge very close within its edge; surface perfectly smooth, or with very faint laminar lines of growth parallel with the margins. Length of large, rather imperfect specimen $5\frac{1}{2}$ inches, proportional greatest width at posterior end about $\frac{30}{100}$, greatest depth $\frac{8}{100}$ or $\frac{9}{100}$.

Fragments of this species might be taken for a *Solen*, and the *S. siliquoides* (Kon.) may have some affinity with it, though specifically distinct. The muscular impression is rather large, though superficial, quadrato-reniform, rather behind the middle of the length, and nearer to the cardinal than the ventral margin.

Specimens of the above large size, rare in the carboniferous limestone of Derbyshire; specimens about 3 inches long, and slightly more convex, in the carboniferous limestone of Lowick, Northumberland.

(*Col.* University of Cambridge.)

Cardiomorpha orbicularis (M'Coy).

Desc. Suborbicular; anterior end moderately large, semicircular, compressed; ventral and posterior margin very convex, regularly curved; posterior side small, rounded, gradually compressed; beaks very large, tumid, obliquely inrolled towards the anterior end, projecting greatly beyond the hinge, nearly over which is the deepest part of the shell; valves becoming gradually flattened towards the margins; surface smooth, even; substance of the shell very thin; hinge-margin inflected at right angles, forming a cartilage support rather less than 2 lines wide. Length 3 inches 2 lines, proportional width from beak to ventral margin $\frac{90}{100}$, length of anterior end $\frac{18}{100}$, width half-way between the beak and posterior end $\frac{65}{100}$, depth (greatest near the beak) $\frac{35}{100}$.

This is only likely to be confounded with the *C. oblonga* (Sow. sp.), but is distinguished by its large anterior and small posterior sides, extremely large beaks, and flattened orbicular valves. The *young* of the *C. corrugata* (M'Coy), which is nearly like in form, is distinguished by the large corrugations of the sides.

Seems not uncommon in the carboniferous limestone of Derbyshire.

(*Col.* University of Cambridge.)

Lithodomus Jenkinsoni (M'Coy).

Desc. Longitudinally oblong or oval, subcylindrical; beaks small, much incurved, obliquely inrolled over the wide, deep, cordate, anterior lunette; anterior end very short, extending very slightly in front of the beaks, obtusely rounded; posterior end slightly wider than the anterior, obtusely rounded; dorsal margin nearly straight, gradually rounding into the posterior end; ventral margin very slightly convex; valves evenly tumid, most so along an undefined line from the beaks to the respiratory margin a little in front of the middle of the length; surface with irregular, coarse, concentric lines and

plicæ of growth. Casts show the large anterior and posterior adductor impressions distinctly connected by the simple pallial scar, together with faint traces of the concentric plicæ of the surface, crossed by microscopic, close, diagonal striæ from the beaks towards the respiratory margin; also an impression of the small cartilage ridge within the dorsal margin. Length 1 inch 7 lines, proportional depth greatest at middle of length $\frac{45}{100}$, depth at posterior end $\frac{40}{100}$, from apex of beaks to ventral margin $\frac{20}{100}$, length and width of anterior lunette $\frac{12}{100}$, greatest depth of both valves $\frac{42}{100}$, length of anterior end $\frac{10}{100}$.

This is a smaller and much more obtuse species than the *L. dactyloides* (M'Coy), the anterior end being proportionally broader and more obtusely rounded; the posterior end is also less pointed, and the anal angle not elevated. I have not seen the external shell of this species, except near the margins, and here there is no trace of the distinct longitudinal or radiating striation of that species, traces of which are however seen on the internal casts. I dedicate this species to the Rev. Mr. Jenkinson of Lowick, to whose labours we owe the most extensive and beautifully perfect local collection perhaps ever made—particularly instructive by the frequent exhibition of internal characters.

Not uncommon in the impure carboniferous limestone of Lowick, Northumberland.

(*Col.* University of Cambridge.)

Edmondia rudis (M'Coy).

Desc. Rotundato-quadrate, very gibbous; beaks very large, obtuse, posterior end broad, subtruncate, very slightly oblique; posterior slope flattened, steep, undefined; anterior end subtruncate, abruptly compressed; ventral margin gently convex; hinge-line nearly as long as the shell, slightly raised, middle of the shell with very unequal rugged plicæ, parallel with the ventral margin, anterior and posterior slopes evenly smooth. Length 1 inch 1 line, proportional width $\frac{85}{100}$, width of posterior end $\frac{80}{100}$, length of anterior end $\frac{15}{100}$, depth of one valve $\frac{26}{100}$.

The short, quadrate, extremely gibbous form and unequal rugged plicæ distinguish this species from all other carboniferous fossils that I know at a glance. There is often a sort of large obscure pitting between the plicæ. The cardinal cartilage ridge is very thick, and nearly as long as the hinge-line or simple erect cardinal margin.

Rare in the impure carboniferous limestone of Lowick, Northumberland.

(*Col.* University of Cambridge.)

Murchisonia dispar (M'Coy).

Desc. Elongate, very acutely conic; apical angle 30°; spire of about eight very gradually increasing tumid whorls having a very thick obtuse prominent band, forming a rounded keel much nearer the lower than the upper suture; upper and lower surfaces slightly tumid, convex, the lower portion most steeply sloped; the band is either simple, or rarely with three spiral striæ; two strong spiral lines below the keel, and six slightly smaller ones above it on each whorl; base of body-whorl rounded, convex, with an obtuse angulation at such a distance below the keel, that it is just concealed by the suture on the spiral whorls; lines of growth five, unequal, obscure, slightly arched, oblique to the band. Length 7 lines, proportional width $\frac{50}{100}$, height of last whorl $\frac{45}{100}$, height of penultimate whorl $\frac{20}{100}$.

This species is easily distinguished from its allies, the *M. subsulcata* and *M. Archiacana*, De Koninck, and *M. Larconi*, M'Coy, by the disparity in width of the parts of the whorls above and below the band, and the disparity in number of the keels or spiral striæ which ornament those parts.

Not very uncommon in the impure carboniferous limestone of Lowick, Northumberland.

(*Col.* University of Cambridge.)

Pleurotomaria decipiens (M'Coy).

Desc. Var. α. Spire acute, regularly conic; apical angle about 40°; composed of about seven or eight gradually increasing flat whorls; suture a simple impressed line; base of body-whorl flattened, forming a strong angle with the spire; no umbilicus; pillar-lip slightly thickened, arched; mouth oblong angulated, a little wider than long; surface marked with narrow thread-like spiral ridges, separated by flat or slightly concave spaces about three times their width; about eight or nine spiral ridges on each whorl, and seven or eight more rather stronger on the base, the intervening spaces very irregularly cancellated by obscure, unequal, obtuse, longitudinal wrinkles, very slightly oblique to the band, forming an obscure irregular, quadrate pitting, occasionally visible on the cast, these transverse plicæ closer and more oblique on the base; band about the width of the ordinary spaces between the spiral lines, flat, very inconspicuous, and bounded by very delicate, impressed lines, destitute of the obtuse cancellating plicæ of the rest of the surface, situated two inter-spiral spaces above the lower suture of each whorl. Width 10 lines, proportional

height of last whorl $\frac{65}{100}$, height of penultimate whorl $\frac{40}{100}$, width of mouth $\frac{70}{100}$.

Var. β. Very elongate conic; apical angle about 40°; whorls moderately convex; base of basal whorl gradually prolonged, not flattened nor separated by an angulation from the sides; mouth a little longer than wide. Length of last whorl 11 lines, proportional width $\frac{95}{100}$, height of penultimate whorl $\frac{40}{100}$.

It will be seen that this species has two extreme varieties somewhat resembling those of the *P. yvanni*; the variety α so exactly resembles a *Trochus*, that it requires the most careful examination to detect the extremely obscure, though definite band, to convince the observer that it is a *Pleurotomaria*; the *var.* β, with the basal whorl elongate and rounded in front or at base, like the corresponding variety of *P. yvanni*, is so like a *Macrochilus*, that it is only by carefully tracing the intermediate forms and detecting the very obscure band, noting the same number of spiral ridges on the whorls, &c. that I have become satisfied of their identity; both varieties have usually only four whorls preserved, the posterior end of the animal at that length depositing convex imperforate diaphragms, and becoming naturally decollated.

Both varieties rare in the impure lower limestone of Lowick, Northumberland; the *var.* β rare in the similar limestone of Kendal.

Pleurotomaria erosa (M'Coy).

Desc. Orbicular, depressed, very obtusely conical; apical angle 105°; spire of $4\frac{1}{2}$ rapidly enlarging whorls; flattened or very slightly convex; sutures fine, simple impressed lines; body-whorl flattened or slightly convex in the upper two-thirds, the periphery very obtusely rounded, close to the broad flattened gently convex base; umbilicus entirely closed, with a large, very thick, semicircular shelly pad; broad, narrow, obscure, bounded by two fine impressed lines; surface glossy, eroded with deep, obtuse, excavated markings without regularity in size, shape or direction; lines of growth arching backwards to the band, scarcely visible. Diameter 5 lines, proportional height $\frac{75}{100}$, height of mouth $\frac{60}{100}$, space between last and penultimate sutures $\frac{20}{100}$, width of umbilical pad $\frac{45}{100}$.

The band of this species is often almost invisible on the periphery of the body-whorl, and the lines of growth can only be traced here and there with a lens. The substance of the shell is very thick, and with the glossy surface, general form, and large umbilical pad recalls *Rotella* (*Pithonellus*) very strongly.

The peculiar "worm-eaten" appearance of the irregular pitting of the surface is equally marked in the two specimens before me.

Rare in the carboniferous limestone of Lowick.

(*Col.* University of Cambridge.)

Macrochilus linnæiformis (M'Coy).

Desc. Elongate fusiform, very acutely rhomboidal, greatest width at about the middle of the total length, from whence the anterior or basal part is conoidally attenuated or rapidly sloped to the greatly narrowed front of columella, and very rapidly sloped to the suture, which is simple and slightly imbricating; spire very abruptly attenuated, long, very slender; sides very concave in the profile of about six or seven whorls (usually five preserved); apical angle 54°; surface polished very smooth, with occasionally fine traces of obsolete direct lines of growth; mouth narrow, elongate, contracted before and behind; anterior part of columella very slightly thickened. Length about 1 inch 7 lines, proportional length of mouth of body-whorl $\frac{70}{100}$, width of body-whorl $\frac{57}{100}$, width of penultimate whorl $\frac{30}{100}$, space between last and penultimate sutures $\frac{13}{100}$, width of mouth $\frac{30}{100}$.

This beautiful species is so totally distinct in form from any of those described that it is unnecessary to compare them. The very abrupt attenuation of the elongate spire gives so much the outline commonly seen in *Linnæa* as to suggest the specific name: in addition to this remarkable peculiarity, the species differs from its congeners in the conoidal attenuation of the produced front, from the line of greatest width of body-whorl, which is at about one-third its length below the suture.

Not very uncommon in the carboniferous limestone of Lowick, Northumberland.

(*Col.* University of Cambridge.)

Macrochilus brevispiratus (M'Coy).

Desc. Elliptical, moderately gibbous, most so about the middle of the length; spire about one-fourth of the total length, pointed; of four whorls gently convex in the middle; sutures slightly imbricating; apical angle varying from 82° to 100°; anterior portion or base produced, moderately convex; surface smooth, with very faint fine striæ of growth visible near the mouth, being scarcely sinuous and very slightly oblique; mouth elongate ovate, indented by the posterior part of the body-whorl; anterior half of columella thickened, arched. Length of rather small specimen 9 lines, proportional length of mouth or last

whorl $\frac{85}{100}$, width of body-whorl $\frac{56}{100}$, width of mouth $\frac{45}{100}$, space between last and penultimate sutures $\frac{15}{100}$.

The extreme shortness of the spire separates this form from all of the genus at once, except the *M. Michotianus* (D'Kon.); from that globose species, it is distinguished by its much more elongate slender form (indicated by the much less proportional width of the body-whorl when compared with the total length), fewer spiral whorls, less convexity, and the whorls sloping gradually to the sutures.

Rare both in the lower carboniferous limestone of Derbyshire, and in the carboniferous limestone of Lowick, Northumberland.

(*Col.* University of Cambridge.)

Straparollus costellatus (M'Coy).

Desc. Discoidal, depressed, very obtusely conic; spire of rather more than six very gradually increasing whorls, each slightly convex above, strongly indenting the suture, which is an impressed sharp line; apical angle 110° (from the obtuseness of the apex its angles would be larger in very young specimens); umbilicus very wide, rounded, half exposing all the whorls; base of body-whorl very convex, rounded, with a very obscure angulation at the edge of the umbilicus; periphery narrowed, obtusely rounded; upper surface of the whorls marked with sharp, slightly sigmoid, rather unequal ridges, arched obliquely backwards, becoming abruptly very much finer and more numerous on passing the circumference to the base (ten of the upper ridges in two lines on the body-whorl), each separated by a sulcus about its own width from the next. Diameter 10 lines, proportional height of spire $\frac{40}{100}$, height of last whorl $\frac{36}{100}$, distance between last and penultimate suture $\frac{15}{100}$, width of umbilicus $\frac{60}{100}$, width of mouth $\frac{40}{100}$.

This species is distinguished from its congeners by the beautifully sharp costellation, or transverse sculpturing of the whorls of the spire, which abruptly cease on the base of the body-whorl, or become there confounded with the lines of growth. The inner lip is complete, but thin, as in other species of *Straparollus*, distinguishing them from *Platyschisma*.

Rare in the lower carboniferous limestone of Lowick, Northumberland.

(*Col.* University of Cambridge.)

Nautilus? *costato-coronatus* (M'Coy).

I give this provisional name to a fragment too imperfect to allow of full description, but so strongly marked, and unlike all

described types, that I wish to call attention to it. The fragment is 7 inches long, and is divided into seven equal chambers, with simple edges; the surface exposed is the periphery, which is broadly rounded, moderately and evenly convex, the sides divided into large conoidal tubercles, each tubercle on one side coincide with one chamber, and there are two chambers between each pair of tubercles, the width of the periphery in our specimen is 6 lines, and it is marked with ten narrow equal card-like, closely tuberculated ridges separated by slightly wider flat spaces.

It strongly resembles the *N. tuberculatus*, Sow., but is distinguished by the costellation of the surface.

Very rare in the carboniferous limestone of Lowick.

(*Col.* University of Cambridge.)

Nautilus tuberosus (M'Coy).

Desc. Discoid, greatest width of the whorls at the angle bounding the periphery, which latter is very wide, moderately concave in the middle, and having the angle on each side undulated into large obtuse tubercles (about $1\frac{1}{2}$ inch from tip to tip on last whorl); sides sloping rapidly with slight convexity to the umbilicus; mouth subquadrate, angles rounded, inner side smaller than the other three. Diameter 7 inches 9 lines, width of last whorl 2 inches 2 lines, width of periphery 2 inches 10 lines, at inner edge 1 inch 10 lines, diameter of umbilicus about $3\frac{1}{2}$ inches.

I have not distinctly seen the surface of this very large species, but it seems to be smooth. The comparative flatness and width of the sides, more quadrate mouth, and deeply concave periphery, easily distinguish it from the *N. tuberculatus* (Sow.), which is the only allied form. In the figure in the 'Mineral Conchology' of *N. tuberculatus* (t. 249) there is an apparent concavity of the section of the periphery, but as this did not agree with the inner outline I doubted its correctness, and on writing to Mr. Sowerby he very kindly furnished me with the exact form of the section of the original specimen, proving that the periphery is strongly and regularly round, contrasting in the strongest manner with the present species, which also wants the medial line of the *N. tuberculatus*. I have only indistinctly seen the septa, which seem to be regular, moderately arched, and rather close. The position of the siphon unknown.

Very rare in the carboniferous limestone of Derbyshire.

(*Col.* University of Cambridge.)

Orthoceras (*Cycloceras*) *Flemingi* (M'Coy).

Desc. Very gradually tapering; section (? broad oval), siphon subcentral large, slightly excentric; septa numerous, moderately convex, one coinciding with each of the external rings. Surface girt with close, obtuse, prominent, transverse rings, little more than their own diameter apart, undulated by about fourteen or fifteen strong longitudinal costæ, slightly further apart than the transverse rings, so that the oblong intervening spaces are wider than long, and nearly equalling them in thickness, both transverse rings and intervening spaces marked by strong transverse imbricating striæ, six or seven between the centre of one transverse ring and the next. A specimen 5 lines long and 2 lines in diameter at the smaller end has twelve rings.

This species can only be confounded with the *O.* (*C.*) *rugosum* of Flem., from which it is distinguished by its much more numerous and closer rings, fewer and larger longitudinal costæ, stronger transverse striæ, and large siphon far removed from the margin.

Very rare in the carboniferous limestone of Lowick, Northumberland.

(*Col.* University of Cambridge.)

Orthoceras (? *Poterioceras*) *cornu-vaccinum* (M'Coy).

Desc. Conical, rapidly tapering to an obtusely rounded point, very slightly arched; section perfectly circular throughout; septa very oblique, flattened, slightly convex, moderately approximate, extending much further forward on the inner side of the general curve than on the outer or convex aspect, the lateral edges being very slightly sigmoidal, on account of their obliquity; the septa are broad oval in form, the *longest diameter being in the antero-posterior direction*; siphon large, about its own diameter within the outer edge (corresponding with the convexity of the general curve of the shell). Surface horny in appearance, marked with irregular scratch-like longitudinal markings, and fine, nearly regular transverse impressed lines, separated by rather wider flattened spaces; thirteen transverse striæ in 2 lines at an inch and a quarter in diameter, about twenty in the same space at 9 lines in diameter. Length of average specimen·5 inches 9 lines, 2 inches 3 lines in diameter at the anterior end, and regularly tapering to the obtusely pointed apex in the above length; average distance of the last few septa 2 lines.

The above measurements are of average-sized specimens,

although examples occasionally occur a couple of inches long. The general, slightly curved, obtusely pointed, rapidly tapering form, and peculiar horny looking texture have suggested the specific name. The only described fossil it has any resemblance to is the *Cyrtoceras Verneuilanum* of De Koninck (A. F. B. t. 48. f. 6), but it is easily distinguished by that species having a broad oval transverse section, while the section of the present fossil is perfectly circular; and the septa which from their obliquity appear oval, have their long axis directed in the opposite direction; the curvature is also less in our fossil. Some of the specimens show a very slight contraction at the mouth, which renders it probable that the species belongs to the subgenus *Poterioceras*, with which all the other characters agree exactly and better than with any other section of *Orthoceras*.

Not very uncommon in the carboniferous limestone of Lowick, Northumberland.

(*Col.* University of Cambridge.)

BIBLIOGRAPHICAL NOTICES.

A Naturalist's Rambles on the Devonshire Coast. By P. H. Gosse, A.L.S. &c. London: John Van Voorst, 1853.

We shall do our readers a service at this season of the year, when so many are seeking health and relaxation by the sea-shore, by directing their attention to this very pleasing and useful work. Armed with this and Dr. Harvey's excellent 'Sea-side Book*,' every pool will be found to offer ample sources of amusement and instruction, and they may bid defiance to that dire ennui which would appear to be the source of the ordinary melancholy amusements of a 'watering place.' We do not mean to say that people who go for relaxation to the sea-side should bore themselves by taking microscopes and scalpels and making scientific observations; but without going at all deeply into the subject, the search for zoophytes and mollusks will give their walks something of the excitement of a hunt, and bringing them home—watching their odd ways, and finding out all about them in the books—will originate a vast deal of interest, and a great deal of fun and humour into the bargain. At least so we have found it, and we dare not venture to imagine that the 'gentle reader' is a more dry and adust personage than ourself.

Most persons have a gustatory interest in Prawns, and indeed one considers it to be part of one's mission at the sea-side to devour them at breakfast and tea; but how few of us there are who are aware that

* Published by Van Voorst,—a book popular enough to cause a 'Religious' Society to put forth a work with a title so similar, that those who look no further might be readily deceived. We trust our readers will take care to discourage this pious aberration.

the thing we pluck off with our fingers, not without inward murmurings at the absurd complexity of Palæmonic structure, has such a dignified name as 'Cephalo-thorax.' Still less that the well-flavoured red thing when alive can deserve so much eloquence as Mr. Gosse has expended upon him in the following passage:—

"Large Prawns swim at freedom through this large pool; and a very pleasing sight it is to watch them as they glide gracefully and equally along; the tail-fans are widely dilated, rendering conspicuous the contrasted colours with which they are painted; the jaws are expanded, the feet hanging loosely beneath. Now one rises to the surface almost perpendicularly; then glides down towards the bottom, sweeping up again in a graceful curve. Now he examines the weeds, then shoots under the dark angles of the rock. As he comes up towards me I stretch out my hand over the water; in an instant he shoots backwards a foot or so; then catching hold of a weed with his feet and straddling its vertical edge, he remains motionless, gazing up at me with his large prominent eyes as if in the utmost astonishment.

"This Prawn, that comes to our tables decked out and penetrated, as it were, with a delicate pellucid rose colour, beautiful as he is then, is far more beautiful when just netted from the bottom, or from the overhanging weed-grown side of some dark pool. If you happen never to have seen him in this state let me introduce him to you; form and dimensions of course you are acquainted with; these do not change, but I will just observe that it is a 'sizeable' fellow that is now before me, whose portrait I am going to take. Stand still, you beauty! and don't shoot round and round the jar in that retrograde fashion, when I want to jot down your elegant lineaments! there now he is quiet! quiet but watchful! maintaining a sort of armed neutrality, with extended eyes, antennæ stretching perpendicularly upwards, claws held out divergently with open pincers ready to seize, as if these slender things could do me any harm, and feet and expanded tail prepared in a twinkling to dart backward on the least alarm."

The book is full of such genial and graphic descriptions of marine animals, interspersed with an abundance of carefully made and detailed scientific observations; particularly as regards the Polypes and Medusæ. Mr. Gosse gives some of the best descriptions of the peculiar 'thread-cells' of these animals we have met with, and his observations respecting the effect of light on the colour of Fuci and of Crustacea, upon the development of *Lepralia*, and on the mode in which the *Pecten* performs its leaps, are well worthy of attention. With respect to the latter point we may remark, that whatever may be the case with *Pecten*, we have unquestionably seen the allied genus *Lima* flapping with its valves like a butterfly through the water.

The only faults we have to notice in Mr. Gosse's book arise from that want of acquaintance with foreign literature which is unhappily the rule in English works. Thus he does not seem to know that the structure of the eyes of the Lamellibranchiata has been elaborately described by Krohn and Will, and that a memoir has been devoted

to *Pedicellina* by Van Beneden. Again, much as we regret to deprive a lady of her well-earned honours, we are necessitated to point out that the animal of which he gives an excellent figure and description, and on which, supposing it to be new, he confers the name of *Johnstonella Catharina*, was first described by Eschscholtz in 1825, under the name of *Tomopteris*, afterwards by Quoy and Gaimard as *Briarea*; then by Busch in 1847 and by Grube in 1848, as *Tomopteris*. It is in fact the *Tomopteris onisciformis*, and has a very extensive distribution, having been taken by the present writer in the tropical regions of the South Pacific. It is assuredly an Annelid, but a most remarkable form; and a very excellent description of its structure, by Grube, will be found in Müller's 'Archiv' for 1848.

Lapses of this kind will doubtless be corrected by our author in his second edition, and we take leave of him with our best wishes that he may soon have the opportunity of so doing.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

May 27, 1851.—W. Yarrell, Esq., V.P.L.S., in the Chair.

DESCRIPTIONS OF NEW SPECIES OF TROCHIDÆ (*continued* from p. 148). BY ARTHUR ADAMS, R.N., F.L.S. ETC.

Genus 9. ZIZIPHINUS, Leach.

Calliostoma, Swains.—*Labio*, sp. Oken.—*Trochilus*, sp. Humph.

1. ZIZIPHINUS ZONAMESTUS, A. Adams. *Z. testâ obliquè pyramidali, umbilicatâ, carneâ, cingulis transversis granosis permultis ornatâ; interstitiis purpurascentibus, striis obliquis longitudinalibus; anfractibus planis, supra suturas angulatis, ultimo acutè angulato, basi plano-concavâ, cingulis granulatis insculptâ umbilico magno, infundibuliformi, intus albo; aperturâ rhomboideâ, intus albâ; columellâ rectâ, basi truncatâ.*

Hab. Honduras (*Dyson*).

2. ZIZIPHINUS TICAONICUS, A. Adams. *Z. testâ elevato-conicâ, perforatâ, luteâ vel carneâ, liris transversis rufo articulatis prope suturas ornatâ; anfractibus paulum rotundatis, longitudinaliter striatis, apice atro-purpureo; anfractu ultimo subangulato, basi convexiusculâ, cingulis rufo-articulatis insculptâ; aperturâ subquadratâ; columellâ rectâ, anticè subtruncatâ; aperturâ intus albâ.*

Hab. Island of Ticao, sandy mud, 6 fathoms (*H. C.*).

3. ZIZIPHINUS JAPONICUS, A. Adams. *Z. testâ turrito-conicâ, lævi, nitidâ, imperforatâ; anfractibus planis, basi lineis duabus impressis, ultimo angulato, rubrâ flammulis fuscis et albidis ornatâ, basi convexâ, cingulis articulatis insculptâ; aperturâ subquadratâ, intus viride iridescenti.*

Hab. Japan.

4. Ziziphinus elegantulus, A. Adams. *Z. testâ conicâ, imperforatâ, lutescenti; anfractibus planis, lineis elevatis distantibus granulatis moniliformibus violaceis alternis minoribus cinctâ; interstitiis longitudinaliter striatis; basi planiusculâ, cingulis quatuor violaceis ornatâ; aperturâ subquadratâ, intus albâ; columellâ basi subtruncatâ.*

Hab. Malacca, coral sand, 10 fathoms (*H. C.*).

5. Ziziphinus decussatus, A. Adams. *Z. testâ elevato-conicâ, subperforatâ, albidâ, maculis viridibus longitudinalibus ornatâ; anfractibus planis, basi marginatis, prominulis; cingulis transversis granulatis lineisque elevatis longitudinalibus decussatè insculptâ; anfractu ultimo angulato, basi convexiusculâ, cingulis granulatis ornatâ; aperturâ subquadratâ; columellâ rectâ, basi truncatâ.*

Hab. Calipan, Mindoro, coarse gravel, 12 fathoms (*H. C.*).

6. Ziziphinus rubropunctatus, A. Adams. *Z. testâ parvâ, orbiculato-conicâ, lutescenti; cingulis transversis spinulosis ornatâ (in anfractu ultimo quatuor), interstitiis clathratis pulcherrimè rubro-punctulatis.*

Hab. —— ?

7. Ziziphinus unicinctus, A. Adams. *Z. testâ turrito-conicâ, imperforatâ, luteolâ; anfractibus planis, subimbricatis, basi cingulis prominulis rubro-articulatis lineisque transversis confertis ornatis; anfractu ultimo angulato, basi productâ, lineis concentricis et cingulâ elevatâ articulatâ sculptâ; aperturâ subtrigonâ; columellâ rectâ, basi subcanaliculatâ.*

Hab. Lord Hood's Island, on pearl oysters, 8 to 10 fathoms (*H. C.*).

8. Ziziphinus nebulosus, A. Adams. *Z. testâ conoideâ, imperforatâ, rufo-fuscâ albo variegatâ; anfractibus planiusculis, cingulis inæqualibus granorum ornatâ, ultimo subangulato, basi convexiusculâ, cingulis subgranulosis rufo alboque articulatis ornatâ; aperturâ subtetragonâ; columellâ albâ, incurvatâ, basi subtruncatâ; labro intus lirato.*

Hab. Rains Island (*Ince*).

9. Ziziphinus picturatus, A. Adams. *Z. testâ turrito-conicâ, imperforatâ, viridi aut violaceâ, fasciis undulatis lineisque ziczaciformibus ornatâ; anfractibus planis, basi marginatis crenulatis, lineis impressis transversis sculptâ; anfractu ultimo angulato, basi convexiusculâ; aperturâ subquadratâ, intus albâ; columellâ incurvâ, basi truncatâ.*

Hab. Delaguete, island of Negros, sandy mud, 7 fathoms (*H. C.*).

10. Ziziphinus asperulatus, A. Adams. *Z. testâ conicâ, imperforatâ, albidâ, maculis purpureis radiatim ornatâ; anfractibus planiusculis, in medio carinatis, cingulis inæqualibus ornatâ, superioribus granulatis, inferioribus subplanis; anfractu ultimo*

subangulato, basi planâ, cingulis planis insculptâ; regione umbilicali depressâ, callo obtectâ; aperturâ subrotundâ; columellâ rectâ, basi truncatâ; labro intus lirato.
Hab. ——?

11. Ziziphinus polychroma, A. Adams. *Z. testâ turrito-conicâ, perforatâ, viridi, fasciis albidis undulatis, lineis luteis angulatis variè pictâ; anfractibus planis, subimbricatis; basi marginatis articulatis prominulis, lineis transversis subdistantibus impressis ornatâ, longitudinaliter substriatâ; anfractu ultimo angulato, basi convexiusculâ, cingulis luteo articulatis insculptâ; aperturâ subquadratâ, intus viridi; columellâ rectâ, basi subtruncatâ.*
Hab. Island of Masbate, sandy mud, 7 fathoms (*H. C.*).

12. Ziziphinus duplicatus, A. Adams. *Z. testâ turrito-conicâ, imperforatâ; anfractibus convexis cingulis granorum ornatâ; basi cingulis duabus majoribus prominentibus instructis; interstitiis longitudinaliter striatis; anfractu ultimo subrotundato, basi convexiusculâ, cingulis granorum insculptâ; aperturâ subrotundatâ; labro intus lirato; columellâ basi tuberculo terminatâ.*
Hab. ——?

13. Ziziphinus californicus, A. Adams. *Z. testâ elevato-conicâ, imperforatâ, rufescenti; anfractibus subrotundatis, supra excavatis, liris transversis granulosis, duabus, supra suturam, majoribus; anfractu ultimo subrotundato, basi convexiusculâ; aperturâ subquadratâ; columellâ rectâ, anticè subtuberculatâ.*
Hab. California. (Mus. Cuming.)

Genus 10. Canthiridus, Montfort.

Eleuchus, sp. Humph.; Swains.—*Phasianella*, c., Menke.—*Trochus*, sp. Philippi.

1. Canthiridus cinguliger, A. Adams. *C. testâ elevato-conicâ, cinereâ, punctis fuscis in lineis flammulatis dispositis, transversim sulcatâ; anfractibus planis, cingulâ prominenti supra suturam, anfractu ultimo angulato, cingulo plano cincto; umbilico subobtecto; columellâ rectâ; labro intus albo, lævi.*
Hab. ——?

2. Canthiridus punctulosus, A. Adams. *C. testâ elevato-conicâ, imperforatâ, lævi, nitidâ, cinereâ, transversim sulcatâ; cingulis transversis, luteo alboque punctatis nigro-maculatis ornatâ; anfractibus planis, ultimo acutè angulato; regione umbilicali roseâ; aperturâ subquadratâ; columellâ albâ, rectâ, anticè subtruncatâ; labro intus lævi, limbo punctulato.*
Hab. Swan River, 4 fathoms (*Jukes*).

3. Canthiridus zealandicus, A. Adams. *C. testâ obliquè conicâ, subturritâ, imperforatâ, lævi, nitidâ; atro-purpureâ,*

lineis pallidis transversis, ubique cinctâ; anfractibus paulum convexis; aperturâ obliquâ, subrotundatâ; labio albo, simplici, arcuato; labro intus sulcato, margaritaceo, vividè iridescenti.
Hab. New Zealand.

4. Canthiridus moniliger, A. Adams. *C. testâ elevato-conicâ, imperforatâ, cinereâ, cingulis moniliformibus transversis ornatâ; interstitiis longitudinaliter elevatè striatis; anfractibus planis, apice purpureo, suturâ canaliculatâ; anfractu ultimo angulato; aperturâ subquadratâ; columellâ anticè subtruncatâ; labro intus sulcato.*
Hab. Swan River, 8 fathoms (*Jukes*).

5. Canthiridus articularis, A. Adams. *C. testâ elevato-conicâ, lævi, nitidâ, cinereâ; cingulis confertis, nigro alboque articulatis ornatâ; interstitiis longitudinaliter striatis; anfractibus planis, ultimo angulato, basi planiusculâ, cingulis articulatis sculptâ; aperturâ subquadratâ; columellâ anticè subtruncatâ; labro intus lævi, limbo articulato.*
Hab. ——?

6. Canthiridus artizona, A. Adams. *C. testâ elevatè conoideâ, pallidâ; cingulis carneolis angustis elevatis transversis ornatâ; interstitiis transversim striatis; anfractu ultimo angulato; aperturâ intus viridescenti; labro intus lirato, limbo rufo articulato.*
Hab. ——?

7. Canthiridus rufozona, A. Adams. *C. testâ conoideâ, pallidâ, cingulis rubris transversis interstitiis planis ornatâ; anfractu ultimo rotundato; labro intus albo, lævi, limbo rufo-articulato; columellâ albâ.*
Hab. ——?

8. Canthiridus tenebrosus, A. Adams. *C. testâ parvâ, elevato-conicâ, imperforatâ, subnigrâ, transversim sulcatâ, sulcis albicantibus planis; anfractibus paulum convexis, ultimo subangulato, basi convexâ; aperturâ subrotundatâ, intus albâ, margaritaceâ; labro intus sulcato.*
Hab. ——?

9. Canthiridus nigricans, A. Adams. *C. testâ depresso-conicâ, atro-purpureâ, cingulis elevatis transversis ornatâ; interstitiis longitudinaliter obliquè striatis; anfractu ultimo subangulato; labro intus albo, sublævi, limbo nigro.*
Hab. ——?

10. Canthiridus pallidulus, A. Adams. *C. testâ elevato-conicâ, imperforatâ, pallidâ; cingulis transversis elevatis luteo-articulatis ornatâ; interstitiis concinnè longitudinaliter striatis; columellâ subrectâ, in medio tumidâ; labro intus lirato.*
Hab. Australia.

Genus 11. Eleuchus, Swains.

Phasianella, d., Menke.—*Canthiridus*, sp. Gray.

1. Eleuchus vulgaris, A. Adams. *E. testâ ovato-conoideâ, subturritâ, imperforatâ, lævigatâ, virenti, transversim tenuissimè striatâ; lineis undulatis viridis pictâ, basi convexâ; aperturâ ovatâ; columellâ basi dente acuto terminatâ; labro posticè subangulato.*

Hab. Swan River.

2. Eleuchus rutilus, A. Adams. *E. testâ turrito-conicâ, imperforatâ; spirâ acuminatâ, virido-fuscâ, lineis longitudinalibus rufescentibus ornatâ, transversim striatâ; anfractu ultimo vix angulato; aperturâ intus vividè iridescente; labro viridi marginato.*

Hab. Australia.

Genus 12. Bankivia, Deshayes.

1. Bankivia major, A. Adams. *B. testâ ovato-turritâ, nigro-fuscâ albo variegatâ, lævigatâ, longitudinaliter obliquè striatâ; anfractu ultimo ventricoso, transversim sulcato; columellâ albâ, tortuosâ.*

Hab. Australia. Mus. Cuming.

2. Bankivia nitida, A. Adams. *B. testâ turritâ, acuminatâ, carneolâ, suturis nigricantibus, lævi, nitidâ, transversim tenuissimè striatâ; columellâ anticè tortuosâ; labro ad marginem nigricante.*

Hab. Australia. Mus. Cuming.

Genus 13. Thalotia, Gray.

Elenchus, sp. Humph.—*Helenchus*, Herman.

1. Thalotia zebuensis, A. Adams. *Th. testâ elevato-conoideâ, perforatâ, atro-fuscâ, fasciis longitudinalibus ornatâ, transversim sulcatâ; anfractibus planulatis, ultimo rotundato, basi convexâ; labio subrecto, anticè reflexo, dilatato; aperturâ subcirculari, intus albâ; labro intus lævi, atro-marginato.*

Hab. San Nicholas, island of Zebu, sandy mud, 6 fathoms (*H.C.*).

2. Thalotia strigata, A. Adams. *Th. testâ turrito-conicâ, perforatâ, albidâ, fasciis latis rufo-fuscis radiatâ; anfractibus in medio angulatis porcis transversis subgranulosis, interstitiis longitudinaliter striatis ornatâ, basi convexâ, concentricè porcatâ; umbilico aperto; aperturâ subrotundatâ; columellâ subflexuosâ, basi truncatâ; labro intus lirato, margine crenulato.*

Hab. Swan Point, N. Australia (*Dring*).

3. Thalotia zebrides, A. Adams. *Th. testâ turrito-conicâ, subperforatâ, virescenti, lineis atro-purpureis longitudinalibus ornatâ, porcis transversis confertis sculptâ, longitudinaliter striatâ, basi convexâ; umbilico subobtecto; columellâ sinuatâ, callo terminatâ; labro intus lirato, margine atro-purpureo articulato.*

Hab. ——?

4. Thalotia suturalis, A. Adams. *Th. testâ conicâ, subperforatâ, virescenti, lineis purpureis longitudinalibus undulatis ornatâ, transversim liratâ, longitudinaliter striatâ; anfractibus planis, supra suturam elevatis; suturâ canaliculatâ, basi planiusculâ; columellâ brevi, basi tuberculo terminatâ; labro intus lævi, viridi.*

Hab. Cape Upstart, Torres Straits, Australia, under stones, low water (*Dring*).

5. Thalotia tricingulata, A. Adams. *Th. testâ conicâ, imperforatâ, nigrâ, lineis albis longitudinalibus ornatâ; anfractibus angulatis, ultimo cingulis tribus transversis prominentibus instructo, basi convexâ, cingulis concentricis nigro alboque articulatis ornatâ; labio ad basin tuberculato; aperturâ subrotundatâ, intus albâ; labro intus liris elevatis, atro-marginato.*

Hab. ——?

6. Thalotia crenellifera, A. Adams. *Th. testâ elevato-conicâ, imperforatâ, rufescente, rubro maculosâ; spirâ acuminatâ, apice rubro; anfractibus planulatis, liris confertis, crenellatis, transversis, interstitiis obliquè longitudinaliter striatis; anfractu ultimo subangulato, basi convexiusculâ; aperturâ subquadratâ, intus albâ; columellâ albâ, incurvatâ, anticè truncatâ.*

Hab. Australia. Mus. Cuming.

Genus 14. Monodonta, Lamarck.

Monodon, Schweiger.—*Monodontes*, Montfort.— *Odontis*, Sow.— *Trochidon*, Swains.—*Diloma*, Phil.—*Trochulus*, sp. Humph.

1. Monodonta rugulosa, A. Adams. *M. testâ ovato-conoideâ, depressâ, atro-fuscâ, fasciis latis luteo-albis irregulariter pictâ, cingulis rotundatis interruptis ornatâ; columellâ basi bituberculatâ, canali parallelo instructâ, dente magno acuto terminatâ; labro duplicato, intus lirato.*

Hab. ——?

2. Monodonta circumcincta, A. Adams. *M. testâ ovato-conoideâ, imperforatâ, lævi, nitidâ, crassâ, cingulis rubris albo viridi maculatis alternantibus pictâ; anfractibus convexis; columellâ basi tuberculatâ, dente magno acuto terminatâ; labro duplicato, intus lirato.*

Hab. Island of Ticao, on the stones on reefs at low water (*H. C.*).

3. Monodonta tuberculata, A. Adams. *M. testâ ovato-conoideâ, imperforatâ, crassâ, viridescenti, cingulis tuberculorum oblongorum violaceorum ornatâ; anfractibus convexis; columellâ basi trituberculatâ, canali parallelo instructâ, dente prominente acuto terminatâ; labro duplicato, intus lirato.*

Hab. ——?

Subgenus Aradasia, Gray.

Operculum suborbicular, paucispiral.

Aradasia, Gray, in Mrs. Gray's Figures of Molluscous Animals, p. 90. —? *Otavia*, Cantr.

1. Monodonta sulcifera, A. Adams. *M. testâ globoso-*

conicâ, umbilicatâ, fuscâ, cingulis granorum distantium moniliformibus, interstitiis profundè sulcatis, sulcis sublævibus longitudinaliter striatis ornatâ; columellâ ad basin trisulcatâ, dente parvo acuto instructâ; labro tenui, intus sulcato.

Hab. Roebuck Bay, North Australia (*Dring*).

2. MONODONTA CLATHRATA, A. Adams. *M. testâ ovato-conoideâ, albâ, imperforatâ, cingulis subgranosis distantibus ornatâ, in anfractu ultimo septem, interstitiis costulis longitudinalibus eleganter clathratis; columellâ tuberculo parvo terminatâ; labro intus sulcato.*

Hab. Guidulman, island of Bohol, rocky ground, 60 fathoms (*H. C.*).

3. MONODONTA TRICINGULATA, A. Adams. *M. testâ globoso-conoideâ, umbilicatâ, rubente, albo et fusco variegatâ, cingulis parvulis granorum ornatâ; suturâ canaliculatâ; anfractibus convexis, carinis tribus transversis prominentibus cinctis; umbilico profundo; columellâ ad basin tuberculo parvo terminatâ; labro expanso, tenui, intus lævi.*

Hab. Malacca; Singapore, fine sand, 6 fathoms (*H. C.*).

4. MONODONTA PHILIPPINA, A. Adams. *M. testâ globoso-conicâ, perforatâ, fuscâ nigro punctatâ; cingulis granulatis inæqualibus ornatâ, interstitiis clathratulis; umbilico parvo; columellâ tuberculo parvo terminatâ; labro intus sulcato.*

Hab. Puerto Galero, island of Mindoro, in coarse sand, 9 fathoms; Bolinao, province of Zambales, island of Luzon, sandy mud, 10 fathoms (*H. C.*).

5. MONODONTA EDENTULA, A. Adams. *M. testâ ovato-conoideâ, umbilicatâ, fuscâ, costellis transversis imbricatis, interstitiis clathratis sculptâ; anfractibus valde rotundatis; umbilico infundibuliformi; columellâ subrectâ, basi tuberculo terminatâ; labro margine crenulato.*

Hab. Catbalonga, island of Samar, sandy mud, 6 fathoms (*H. C.*). Mus. Cuming.

6. MONODONTA FOVEOLATA, A. Adams. *M. testâ globoso-conoideâ, subperforatâ, crassâ, albâ, cingulis transversis nodulosis subdistantibus (in anfractu ultimo septem), interstitiis costellis longitudinalibus foveolatis ornatâ; columellâ dente minuto terminatâ; labro intus crasso et lirato.*

Hab. Lord Hood's Island, on pearl oysters, 8 to 10 fathoms (*H. C.*). Mus. Cuming.

7. MONODONTA EXIGUA, A. Adams. *M. testâ parvâ, conoideâ, umbilicatâ, albidâ fusco variegatâ, cingulis transversis granulosis interstitiis longitudinaliter liratis ornatâ; anfractibus parum convexis, ultimo subangulato; umbilico recto, dente valido acuto terminatâ; labro intus sulcato.*

Hab. Japan (*Siebold*).

8. MONODONTA RUBRA, A. Adams. *M. testâ globoso-conoideâ, umbilicatâ, rubrâ, cingulis transversis granorum moniliformibus*

æquantibus interstitiis lineis longitudinalibus impressis ornatâ; anfractibus rotundatis, suturâ canaliculatâ, umbilico magno; columellâ rectâ, dente prominente terminatâ; labro intus crasso, sulcato.

Hab. ——?

9. Monodonta alveolata, A. Adams. *M. testâ globoso-conoideâ, umbilicatâ, albidâ, fasciis fuscis longitudinalibus undulatis pictâ, cingulis transversis granorum acutorum interstitiis costis longitudinalibus alveolatis ornatâ; suturâ canaliculatâ; umbilico angusto; columellâ rectâ, dente valido terminatâ; labro intus valde lirato.*

Hab. Guidulman, island of Bohol, rocky ground, 60 fathoms; Baclayon, island of Bohol, under stones, low water; island of Capul, on the reefs at low water (*H. C.*). Mus. Cuming.

10. Monodonta angulifera, A. Adams. *M. testâ elevato-conoideâ, imperforatâ; anfractibus planiusculis, imbricatis, infernè angulatis, longitudinaliter nodoso-costatis, cingulis transversis tuberculorum subdistantium interstitiis alveolatis ornatâ; anfractu ultimo subangulato; columellâ rectâ, brevi, dente parvo terminatâ; labro subduplicato, intus sulcato.*

Hab. Puerto Galero, island of Mindoro, sandy mud, 6 fathoms (*H. C.*). Mus. Cuming.

11. Monodonta strangei, A. Adams. *M. testâ conoideâ, perforatâ, fuscâ, cingulis granorum æqualibus confertis ornatâ; anfractibus parum convexis, ultimo subangulato; columellâ curvatâ, dente obtuso terminatâ; labro intus sulcato, tuberculo propè basin columellæ.*

Hab. Sydney, under stones (*Strange*).

12. Monodonta punctigera, A. Adams. *M. testâ globoso-conoideâ, umbilicatâ, albâ fusco punctatâ, cingulis granulosis inæqualibus rufo-punctatis ornatâ; suturâ canaliculatâ; anfractibus rotundatis; umbilico aperto, infundibuliformi; columellâ rectâ, brevi, basi bituberculatâ, dente parvo acuto terminatâ; labro expanso, intus sulcato.*

Hab. Singapore, fine sand, 6 fathoms (*H. C.*). Mus. Cuming.

13. Monodonta exasperata, A. Adams. *M. testâ globoso-conoideâ, umbilicatâ, subdepressâ, albidâ nigro-variegatâ, cingulis spino-granulatis exasperatâ; columellâ sinuatâ, dente prominenti terminatâ; labro incrassato, duplicato, intus valde lirato.*

Hab. Sibonga, island of Zebu, at low water (*H. C.*); island of Siquijor, under stones. Mus. Cuming.

14. Monodonta spilota, A. Adams. *M. testâ parvâ, ovato-depressâ, conoideâ, imperforatâ, lævi, nitidâ, viridi, maculis pallidis triangularibus; columellâ planâ, albâ, canali parallelo instructâ, dente obtuso terminatâ; labro duplicato, intus lirato.*

Hab. ——?

15. Monodonta lirostoma, A. Adams. *M. testâ elevato-conicâ, imperforatâ, albidâ; anfractibus planis, cingulis tribus granulatis, interstitiis valde clathratis; suturâ canaliculatâ; anfractu ultimo angulato; columellâ tuberculatâ; labro intus valde lirato.*

Hab. Lord Hood's Island, on pearl oysters, 8 to 10 fathoms (*H.C.*). Mus. Cuming.

Genus 15. Labio, Oken.

Osilinus, Philippi.—*Trochius*, Leach.—*Gibbium*, Gray.—*Monodonta*, sp. Lamck.—*Melagraphia*, Steutz.

1. Labio porcata, A. Adams. *L. testâ ovato-conoideâ, imperforatâ, fuscâ albo reticulatâ; anfractibus convexis, transversim carinatis, carinis numerosis, elevatis, distantibus; labio albo, infernè subcalloso; labro intus sulcato.*

Hab. Australia.

2. Labio porcifera, A. Adams. *L. testâ orbiculato-conicâ, imperforatâ, fulvescente, liris transversis æquidistantibus nigro-articulatis ornatâ; longitudinaliter obliquè striatâ; labio plano, regione umbilicali impresso; columellâ tuberculis duobus, inferiore majore; labro intus duplicato, margine luteo nigro-articulato.*

Hab. ——?

3. Labio rudis, A. Adams. *L. testâ orbiculato-conicâ, imperforatâ; spirâ obtusâ, lutescente, lineis transversis nigris ornatâ, longitudinaliter obliquè striatâ, transversim subexaratâ; labio complanato; columellâ anticè subtuberculatâ; labro nigro luteoque intus marginato.*

Hab. Australia.

4. Labio fuliginea, A. Adams. *L. testâ orbiculato-conicâ, imperforatâ, nigrâ, liris transversis æquidistantibus luteo-articulatis ornatâ; regione umbilicali impressâ; columellâ tuberculis duobus, antico majore; labro duplicato, nigro-marginato.*

Hab. ——?

5. Labio corrosa, A. Adams. *L. testâ turbinatâ, imperforatâ, spirâ elevatiusculâ, anfractibus rotundatis, rugosâ, cinereo-lutescente; anfractu ultimo subangulato; labio complanato; columellâ simplici; labro luteo marginato.*

Hab. New Zealand (*Hart*).

6. Labio concolor, A. Adams. *L. testâ turbinato-conicâ, imperforatâ; spirâ acutâ, brunneâ, longitudinaliter obliquè striatâ, transversim subliratâ; labio complanato, regione umbilicali impresso; columellâ arcuatâ, anticè tuberculo terminatâ; labro nigro-fusco marginato.*

Hab. New Zealand (*Hart*).

Genus 16. Chlorostoma, Swainson.—*Oxystele*, Philippi.

1. Chlorostoma castaneum, A. Adams. *C. testâ obliquè conicâ, umbilicatâ, castaneâ; anfractibus planis, longitudinaliter obsoletè nodoso-plicatis et obliquè striatis, penultimo infra marginato, ultimo acutangulo, basi concavo pallidè fuscâ, lineis viridi-fuscis radiatim pictâ; umbilico infundibuliformi, perspectivo, intus albo, peromphalo albo lineâ elevatâ cincto; aperturâ subrhomboideâ; columellâ supra sinuatâ, basi dente terminatâ.*
Hab. ——?

2. Chlorostoma undulosum, A. Adams. *C. testâ globoso-conicâ, imperforatâ; spirâ depressâ, virescenti lineis undulatis atro-purpureis longitudinalibus ornatâ, longitudinaliter substriatâ; labio complanato, margine columellari subtuberculato; labro intus sulcato, margine luteo, atro-purpureo articulato.*
Hab. New Zealand (*Earl*).

3. Chlorostoma turbinatum, A. Adams. *C. testâ turbinatâ, profundè umbilicatâ, nigrâ; spirâ obtusâ, longitudinaliter subplicatâ, transversim sulcosâ; anfractu ultimo rotundato, regione umbilicali partim callo lutescente obtectâ; columellâ anticè bituberculatâ; labro nigro marginato.*
Hab. ——?

4. Chlorostoma rugosum, A. Adams. *C. testâ turbinato-conoidali, profundè umbilicatâ, luteo-fuscâ, nigro variegatâ, longitudinaliter nodoso-plicatâ, transversim sulcatâ; anfractu ultimo rotundato, infra suturam angustato; columellâ incurvatâ, anticè bituberculatâ, tuberculo supremo magno, prominente; labro fusco marginato.*
Hab. ——?

5. Chlorostoma corrugatum, A. Adams. *C. testâ orbiculato-conoidali, profundè umbilicatâ; spirâ subacutâ, longitudinaliter corrugato-plicatâ et obliquè striatâ; anfractu ultimo subrotundato, basi plano convexo, regione umbilicali albido subcalloso; columellâ tuberculis duobus, supremo magno.*
Hab. ——?

6. Chlorostoma tropidophorum, A. Adams. *C. testâ orbiculato-depressâ, profundè umbilicatâ; spirâ brevi, nigrâ, transversim sulcatâ, cingulis transversis prominentibus ornatâ; anfractu ultimo carinato, basi concentricè exarato, regione umbilicali albo sulco circulari circumdato; columellâ tuberculis duobus, supremo acuto, prominente.*
Hab. Valparaiso.

7. Chlorostoma maculosum, A. Adams. *C. testâ conicâ, profundè umbilicatâ, viridi-fuscâ, maculis nigro-fuscis ornatâ; anfractibus planulatis, longitudinaliter substriatis, transversim striatis; anfractu ultimo angulato, basi concavo; columellâ anticè tuberculo acuto terminatâ.*
Hab. ——?

8. Chlorostoma seminodosum, A. Adams. *C. testâ depresso-conicâ, profundè umbilicatâ, fuscâ; anfractibus planulatis, supernè subnodosis, longitudinaliter obliquè striatis; anfractu ultimo angulato, supra angulum cingulâ transversâ elevatâ ornato, basi planiusculâ; columellâ tuberculis duobus, supremo acuto, prominente.*
Hab. ——?

9. Chlorostoma articulatum, A. Adams. *C. testâ orbiculato-conicâ, umbilicatâ, nigro-fuscâ, cingulis transversis elevatis albo-articulatis ornatâ; anfractu ultimo subangulato, basi cingulis albo-articulatis instructo, regione umbilicali viridi; columellâ tuberculo parvo terminatâ.*
Hab. ——?

10. Chlorostoma xanthostigma, A. Adams. *C. testâ conoideâ, imperforatâ, glabrâ, nigrâ, longitudinaliter obliquè substriatâ; anfractibus parum rotundatis, basi concentricè lirato, luteo-carneolo; regione umbilicali callo luteo obtectâ; columellâ arcuatâ, basi dente terminatâ et infra tuberculo instructâ.*
Hab. ——?

11. Chlorostoma turbinatum, A. Adams. *C. testâ ovato-conoideâ, imperforatâ, castaneâ, lævi, longitudinaliter obliquè striatâ, striis transversis indistinctis insculptâ; anfractibus rotundatis, suturâ angustè canaliculatâ, regione umbilicali impressâ; labio curvato, basi dente et tuberculo terminatâ; labro intus sulcato.*
Hab. ——?

Genus 17. Gibbula, Leach.

Trochus, sp. Linn.—*Steromphala*, Leach.—*Monodonta*, sp. Lam

1. Gibbula sulcosa, A. Adams. *G. testâ conoideâ, umbilicatâ, maculis roseis flammulis albo-punctatis variegatâ, anfractibus paulum convexis, longitudinaliter substriatâ, transversim sulcatâ, sulcis subdistantibus, anfractu ultimo subangulato, basi convexiusculâ, lineis impressis concentricis sculptâ; aperturâ suborbiculari; columellâ supernè sinuatâ, basi subtruncatâ.*
Hab. Sir C. Hardy's Island, North Australia, 8 fathoms, coarse sand (*Mr. Jukes*).

2. Gibbula mindorensis, A. Adams. *G. testâ elevato-conoideâ, perforatâ, viridi-fuscâ, fasciis pallidis longitudinalibus ornatâ; anfractibus rotundatis, liris transversis subgranulosis cinctis, ultimo subangulato, basi convexâ; columellâ subrectâ, basi tuberculo terminatâ; labro intus sulcato.*
Hab. Puerto Galero, island of Mindoro, in coarse sand, 9 fathoms (*H. C.*).

3. Gibbula undosa, A. Adams. *G. testâ orbiculato-conoideâ, umbilicatâ, virescenti, lineis fusco-viridibus undatis longitudina-*

libus pictâ; anfractibus rotundatis, transversim tenuè liratis, ultimo subangulato, basi convexâ; aperturâ expansâ, intus iridescenti; columellâ supernè sinuatâ, basi rotundatâ.
Hab. ——?

4. Gibbula porcellana, A. Adams. *G. testâ depresso-conicâ, latè umbilicatâ, glabrâ, solidâ, nitidâ, lacteâ, lineis radiantibus undulatis pulcherrimè pictâ; anfractibus planis cingulis prominentibus, duabus maculis albis et rufo-fuscis vividè pictis ornatâ; interstitiis transversim sulcatis, basi convexiusculâ, cingulis concentricis lineis maculisque rufo-fuscis ornatâ; umbilico perspectivo, intus concentricè lirato, margine lineâ elevatâ cincto; columellâ subrectâ, basi rotundatâ.*
Hab. New Holland.

5. Gibbula pulchra, A. Adams. *G. testâ orbiculato-conicâ, umbilicatâ, roseâ, ad suturam albo luteo fuscoque radiatim pulcherrimè pictâ; anfractibus planis, biangulatis, transversim sulcatis, sulcis rubro-articulatis, anfractu ultimo angulato, cingulâ albo luteo nigro fuscoque eleganter pictâ, basi convexâ, concentricè sulcatâ; umbilico intus albo, basi rotundatâ.*
Hab. Australia.

6. Gibbula Kalinota, A. Adams. *G. testâ orbiculato-conoideâ, perforatâ, virescenti, carneo cinereo variegatâ; anfractibus rotundatis, lineis elevatis albo-articulatis, supernè gibbosis; suturâ profundâ, anfractu ultimo rotundato, basi convexâ, cingulis articulatis concentricis ornatâ, margine umbilici angulato, lineâ elevatâ cincto; columellâ supernè sinuatâ, basi subtruncatâ; labro intus lævi.*
Hab. ——?

7. Gibbula venusta, A. Adams. *G. testâ orbiculato-conoideâ, umbilicatâ, viridi-fuscâ, maculis albis prope suturas, cingulis subdistantibus fusco rubroque articulatis, interstitiis liratis, longitudinaliter obliquè striatâ; anfractibus supernè gibbosis, rubro pictis; suturâ canaliculatâ, anfractu ultimo rotundato, basi convexiusculâ, cingulis fusco alboque articulatis, regione umbilicali roseo pictâ; columellâ sinuatâ, basi truncatâ.*
Hab. Australia.

8. Gibbula puncto-costata, A. Adams. *G. testâ turrito-conicâ, lutescenti, umbilicatâ; anfractibus supernè cingulis tribus nodulosis, rubro-articulatis nodulis punctatis, infernè liris transversis nodulosis rubro-articulatis, infra, cingulâ puncto-nodosâ basi planâ, cingulis concentricis subnodosis rubro-articulatis ornatâ, margine umbilici lineâ elevatâ cinctâ; columellâ subrectâ, basi truncatâ; labro intus lirato.*
Hab. Island of Capul, on the reefs at low water (*H. C.*).

9. Gibbula leucosticta, A. Adams. *G. testâ conoideâ, perforatâ, nigrâ, punctis lacteis pictâ, anfractibus convexiusculis,*

transversim liratâ, longitudinaliter striatâ, liris subdistantibus albo-punctatis, interstitiis lineis elevatis transversis ornatâ; anfractu ultimo angulato, basi convexiusculâ, cingulis nigro alboque articulatâ; aperturâ subrotundatâ; columellâ supernè sinuatâ, basi rotundatâ.
Hab. Gindulman, island of Bohol, rocky ground (*H. C.*).

10. Gibbula nivosa, A. Adams. *G. testâ orbiculato-conoideâ, umbilicatâ, cinereâ, maculis nivosis subrotundatis pictâ, transversim sulcatâ, longitudinaliter substriatâ; aperturâ subrotundatâ; columellâ flexuosâ, basi rotundatâ.*
Hab. ——?

Genus 18. Monilea, Swainson.—*Talopia*, Gray.

1. Monilea lentiginosa, A. Adams. *M. testâ orbiculato-conicâ, umbilicatâ, albidâ, luteo fuscoque variegatâ; anfractibus rotundatis, cingulis subgranulosis confertis ornatis, ultimo rotundato, basi convexiusculâ, regione umbilicali excavatâ; columellâ supernè callosâ, basi dente terminatâ; labro intus lirato.*
Hab. Ilo Ilo, island of Panay, 7 fathoms (*H. C.*).

2. Monilea kalisoma, A. Adams. *M. testâ orbiculato-conoideâ, umbilicatâ, lutescenti, cingulis purpureo-articulatis ornatâ, cingulis subdistantibus, supremis granulatis, infimis planis; anfractibus planiusculis, ultimo subangulato, basi paulum convexâ, cingulis purpureo-maculatis insculptâ; columellâ supernè sinuatâ, basi dente terminatâ; labro intus lirato.*
Hab. ——?

3. Monilea plumbea, A. Adams. *M. testâ orbiculato-conoideâ, umbilicatâ, plumbeâ; anfractibus rotundis, cingulis granorum transversis in paribus dispositis ornatâ, basi convexâ; umbilico mediocri, intus albo; columellâ brevi, supernè sinuatâ, basi dente terminatâ; labro intus lirato.*
Hab. ——?

4. Monilea lirata, A. Adams. *M. testâ orbiculato-conicâ, umbilicatâ, pallidâ; anfractibus paulum convexis, liris transversis elevatis distantibus, interstitiis decussatè striatis ornatis; anfractu ultimo angulato, basi convexâ, margine umbilici sulco cincto.*
Hab. ——?

5. Monilea pusilla, A. Adams. *M. testâ orbiculato-conicâ, umbilicatâ, rubescenti, fusco variegatâ; anfractibus planiusculis, cingulis granorum transversum distantibus (circa quatuor) ornatis, interstitiis transversim striatis; columellâ in medio sinuatâ.*
Hab. ——?

6. Monilea Swainsonii, A. Adams. *M. testâ conoideâ, umbilicatâ, albidâ, nigro variegatâ; anfractibus planis, cingulis subgranosis, albo nigroque articulatis ornatis, ultimo subangulato,*

basi planiusculâ, cingulis rufo-articulatis ornatâ; columellâ basi tuberculatâ; labro intus lirato.
Hab. ——?

Genus 19. Margarita, Leach.—*Trochus*, sp. Auct.

1. Margarita carinata, A. Adams. *M. testâ elevato-conicâ, perforatâ, fuscâ, liris transversis ornatâ, superioribus duabus costellis longitudinalibus decussatis, inferioribus planis, interstitiis longitudinaliter tenuissimè striatis; basi planiusculâ, cingulis concentricis, interstitiis radiatim striatis insculptâ; margine umbilici crenulato.*
Hab. Catbalonga, coarse sand, 8 fathoms (*H. C.*).

2. Margarita angulata, A. Adams. *M. testâ orbiculato-conicâ, latè umbilicatâ, albidâ, fusco variegatâ; anfractibus supra angulatis, transversim omnino striatis; basi convexâ, concentricè striatâ; umbilico magno, perspectivo.*
Hab. Sandwich Islands.

3. Margarita calostoma, A. Adams. *M. testâ conoideâ, crassâ, perforatâ, transversim valdè sulcatâ, albidâ; anfractibus subrotundatis, ultimo subangulato; aperturâ rotundâ, intus vividè violascenti iridescenti; umbilico callo, columellari subobtecto; labri margine argenteo.*
Hab. Juan de Fuco, Upper California.

4. Margarita Cumingii, A. Adams. *M. testâ elevato-conicâ, cinereâ, lineis fuscis undulatis pictâ, latè umbilicatâ; anfractibus costellis transversis ornatis, ultimo tribus liris intermediis cincto, longitudinaliter elevatè striato; umbilico magno, cingulâ crenulatâ cinctâ, intus lineis radiantibus et transversis eleganter decussato.*
Hab. Philippines.

5. Margarita variabilis, A. Adams. *M. testâ orbiculato-conicâ, subdepressâ, latè umbilicatâ, pallidâ, fusco griseo alboque variè pictâ; anfractibus rotundatis, transversim valdè sulcatis; umbilico perspectivo, margine crenulato; basi planiusculâ; labio margine subcrenulato.*
Hab. ——?

6. Margarita balteata, A. Adams. *M. testâ orbiculato-conicâ, vix umbilicatâ, griseâ, fusco tessellatâ; anfractibus gibbosis, transversim valdè sulcatis; anfractu ultimo subangulato; basi planiusculâ, concentricè sulcatâ; columellâ curvatâ, vix truncatâ.*
Hab. ——?

7. Margarita tessellata, A. Adams. *M. testâ depresso-conicâ, latè umbilicatâ, lævi, cinereâ, regulariter griseo tessellatâ; anfractibus planiusculis, ultimo subangulato; basi convexâ; umbilico intus albido; aperturâ rotundâ, intus viridi-iridescenti.*
Hab. ——?

Subgenus PHOTINA, H. and A. Adams.

Shell smooth, subconical; spire depressed; axis covered by a smooth callus; columella ending in a simple point.

This section includes all the species of *Margarita* that are not umbilicated.

1. PHOTINA NIGRA, A. Adams. *P. testâ depresso-conicâ, imperforatâ, solidâ, nigrâ, lævi; anfractibus subrotundatis, transversim sulcatis; longitudinaliter obliquè substriatâ; anfractu ultimo subangulato; regione umbilicali impressâ; callo albo obtecto.*

Hab. ——?

2. PHOTINA FUSCA, A. Adams. *P. testâ obliquâ, subconicâ, nitidâ, fusco variegatâ; anfractibus parum convexis, transversim sulcatis, ultimo subangulato; aperturâ subrotundatâ, intus viridi iridescenti.*

Hab. ——?

3. PHOTINA SANDWICHIANA, A. Adams. *P. testâ orbiculato-conicâ, imperforatâ, lævi, albidâ, viridi fuscoque maculatâ; anfractibus rotundatis, ultimo subangulato, apice roseo; aperturâ apertâ, orbiculatâ, intus viridi margaritaceâ; labio albo; umbilico callo albo obtecto.*

Hab. Mataineka, Sandwich Islands.

Mr. Oswald then communicated the following remarks by Mr. Mack, on the fact of black eggs being laid by a white duck of the ordinary domestic breed:—

"The egg (observes Mr. Mack) which is herewith sent was laid by a white duck, one of two belonging to Mr. Dickinson of Mitcham, which stray during the day on the common, but are confined at night. The drake was lost about a month since, and then one of the ducks commenced laying black eggs, the other still continuing to lay white ones,—she laid ten or twelve and then ceased for some days; she has again commenced laying black eggs. The ducks are fed once a day with barley, at the time the other poultry are fed.

"Mr. Dickinson, showing the egg this morning to one of the guards on temporary duty on the Brighton rail at Croydon, he said he had a duck which laid the same colour, or even blacker, and that he had raised (at East Bourne) two broods of ducks from black eggs."

Haling Cottage, Croydon, May 24, 1851.

June 10, 1851.—John Gould, Esq., F.R.S., in the Chair.

1. ON TWO NEW SPECIES OF BIRDS OF THE GENUS TÆNIOPTERA. By PHILIP LUTLEY SCLATER, B.A., F.Z.S. etc.

TÆNIOPTERA ERYTHROPYGIA, Sclater. *T. nigrescens; vertice fronte gulâque canescente-griseis; maculâ secundariorum albâ; uropygio, abdomine toto crissoque, cum tectricibus caudæ supe-*

rioribus et alarum inferioribus levitèr brunneo-rufis ; rectricibus brunneo-rufis nigro terminatis ; rostro pedibusque nigris.

Long. tot. 9 unc. 5 lin. ; alæ, 5 unc. 7 lin. ; caudæ, 4 unc. 4 lin. ; rostri à rictû, 1 unc. ; à fronte, 6 lin.

Hab. in republicâ Equatorianâ.

Wings and interscapulars black, growing lighter towards the crown, and greyish white on front and throat; breast darkish grey ; outer web of the last four or five secondaries broadly edged with white, forming a white mark on the wing ; lower back and tail-coverts and whole body beneath below the breast, as also under wing-coverts, light brownish rufous; tail-feathers the same, but broadly tipped with black. For the loan of this and the following species I have to thank Mr. Edward Wilson, who received them from M. Verreaux of Paris. I was at first inclined to refer both species to the genus *Agriornis* of Mr. Gould, but having had through Mr. G. Gray's kindness an opportunity of examining the type of that form, *Agriornis lividus** (Kittlitz), I now consider them better placed in the present genus *Tæniioptera*, with which they agree in all their distinctive characters.

Tænioptera striaticollis, Sclater. *T. suprà saturatè fumoso-brunnea ; uropygio paululùm rufescente tincto ; superciliis rufescente-albidis ; pennis caudâque nigris ; secundariis tertiariisque levitèr brunnescente marginatis ; infrà levitèr brunneo-rufa ; gutture toto colloque albis nigro striatis ; rectricibus remigibusque brunneo-rufis nigro terminatis ; rostro pedibusque nigris.*

Long. tot. 9 unc. 5 lin. ; alæ, 5 unc. 3 lin. ; caudæ, 4 unc. ; rostri à rictu, 1 unc. $\frac{1}{2}$ lin. ; à fronte, $7\frac{1}{2}$ lin.

Hab. in republicâ Equatorianâ.

Above dark smoke-brown ; an obscure whitish line from the bill to the top of the eye ; quill-feathers brown-rufous, outer margins and ends black ; secondaries, tertials, and wing-coverts nearly black, margined with light brown ; beneath brown-rufous ; chin, throat and neck white, with longitudinal striæ of black ; tail-feathers brown-rufous, the two outer broadly tipped with black ; the rest have also the outer web black, except the two medial, which are wholly black. This species is of the same form as the former, from which it may be distinguished by its shorter and weaker beak, and the want of the rufous colouring on the rump and upper tail-coverts, as also by the conspicuous striæ on the neck and throat.

2. Notes on an undescribed species of Tailor-Bird. By Dr. Nicholson.

It may appear irregular to use what has been meant and applied as a specific name, as a generic one, but then that name appears to me to include, and to be indiscriminately applied to, two or three distinct birds, as we may gather by looking at the accompanying sketch, by the examination of the species described by Colonel Sykes as inhabiting the Dukhun, and by reading the following description, taken from Forbes, 'Oriental Memoirs,' p. 34. vol. i., under the

* *Tyrannus gutturalis*, Voy. de la Favorite, Ois. t. 11.

name of *Motacilla sutoria*:—"The Tailor-bird resembles some of the humming-birds at the Brazils in shape and colour; the hen is clothed in brown, but the plumage of the cock displays the varied tints of azure-purple, green and gold, so common in those American beauties... Often have I watched the progress of an industrious pair of Tailor-birds, in my garden, from their first choice of a plant, until the completion of the nest, and the enlargement of their young."

Now, it is evident either that Mr. Forbes alludes to a distinct and an uncommon species, which I have never met with, or else he must have mistaken the common *Cinnyris* or Sun-bird representing the Humming-birds, and both sexes of which he has generally described above. But then the *Cinnyris* builds a common-shaped nest in the fork of a branch, in fashion resembling that of the humming-birds.

This is a resident bird, not very conspicuous, as it keeps hopping about among the brushwood and plants. It has a loud, short, and not unmelodious song; its general cry is 'wheet, wheet, wheet,' often repeated; but its alarm-cry is like 'cheertah, cheertah, cheertah.'

I have found its singular sewn nest containing eggs or young at all seasons of the year, in May and in November; and this may be owing to the vegetation of gardens being always kept up by means of artificial irrigation; for cultivated spots seem its favourite, if not exclusive resort at least in the north of India. Though no doubt it haunts suitable jungles, I never observed it there, nor ever discovered its nest so situated; but I have found many nests in my gardens, both at Surat and at Raghote, as well as in Cutch. It seems to prefer the leaf of the Bringal (*Solanum esculentum*), or that of the *Cucurbita octangularis*, for the purposes of nidification; and it lays four small white eggs, marked with faint dark spots at the larger end. After selecting a fitting leaf, it proceeds by means of its feet and beak to draw the edges together, perforating holes therein, and securing their proximity by threads of cotton, with bunches at the end to prevent their giving way. Then the nest is constructed inside the leaf, now forming a sort of corve, with cotton; the entrance is at the top, and the nest seems small in proportion to the bird. If this bird should prove a distinct species, I would suggest the name of *Sutoria agilis* for it.

Weight of the male $2\frac{1}{2}$ drachms.

Length from bill to tail $5\frac{1}{4}$ inches. Alar extent $6\frac{1}{2}$ inches.

Head: bill long, slender and curved towards the point. Culmen slightly divides the frontal feathers, and is nearly on a line with the top of the head: there is an almost obsolete notch at the end of the upper mandible. Tongue short, slightly extensible, and divided into several filaments at the point. Gape wide, commissure under the eye; a small denuded spot above the commissure. Nostrils basal, pyriform, under a tegument; some small bristles and feathers reflexed from the canthus of the eye towards the bill and over the nares. Eyes small. Iris greenish yellow. Eyelashes edged with small feathers. Eyelids bare. Four remarkable (but inconspicuous) bristles, like feathers, project from the back part of the occiput.

Wings short and perfectly rounded; first quill only half as long as the second; fourth and fifth quills are longest; the second, third

and fourth graduated; the first, third, fourth, fifth, sixth and seventh quills are emarginate on the outer web.

Tail of twelve graduated feathers, the two outer being the shortest; under-coverts are long.

Legs long, the tarsus $\frac{7}{10}$ths of an inch; the outer toe longer than the inner. Hallux very strong, and as long as the outer toe, with a large pad beneath the base, its claw the largest; the tarsus is covered with seven scales in front and one entire behind; two large scales lie across the front of the foot; the claws are curved and sharp.

Contents of stomach a mass of insect exuviæ.

Colours: all above dull green, tinged with ash, light brown towards the end of the tail and quills, which are lighter on the edges. Two-thirds of the front breadth of the neck, round the eye, the breast, belly and thighs (except a chestnut spot on the hallux) are silver-white; there is, besides, a remarkable spot on the neck, of a brown colour, as if the white feathers had been deranged, showing the roots of a different colour. Bill ash-brown or horn-colour, the lower jaw lighter, and both lighter on the edges, as also are the legs and claws of the same colour; forehead of a fine chestnut; crown of olive-brown.

June 24, 1851.—J. E. Gray, Esq., F.R.S., Vice-President, in the Chair.

1. Observations on the Dentition of the Tiger Beetles. By J. O. Westwood, Pres. E.S., F.L.S. etc.

Mr. Westwood directed the attention of the meeting to the necessity which existed of a more precise examination and description of the diversity in the dentition of the mandibles of insects, especially Hymenoptera and Coleoptera, than had hitherto been bestowed thereon. In the higher orders of animals so much importance had been given to this character, that it was remarkable that, in general, entomologists contented themselves with examining, describing, and figuring a single mandible as affording a sufficient diagnosis of the structure of both of the mandibles, overlooking the necessary result which arose from the circumstance of the horizontal instead of perpendicular action of these organs in insects, and the variation in the position of the teeth which such action must necessarily induce. In general, indeed, the teeth of the mandibles were not greatly developed, and there was a general similarity between the two jaws; but when these organs are of an increased size, and especially when the extremity of one jaw laps over that of the opposite one, a diversity in the dentition will necessarily exist. It was likewise necessary to examine the mandibles of both sexes of a species, as it occasionally happened that there was considerable difference in their dentition. These observations were illustrated by the case of the Tiger Beetles (*Cicindelidæ*), which offered a much greater range of diversity in their dentition than had hitherto been supposed. It was chiefly to the genus *Megacephala* that Mr. Westwood directed the attention of the members.

In the type of that genus (*Megacephala senegalensis*, Latr., Dej., *Cic. megalocephala*, Fabr.), an apterous species from Senegal, the right mandible of the male has two large, nearly equal-sized, acute teeth in the middle of the inner margin, the extremity being hooked and very acute; there is also a small tooth at the base of the large, broad, compound basal tooth. The left mandible is nearly similar, except that the two teeth in the middle of the inner margin are unequal in size, the upper one being the smaller of the two. The figure of the jaws of this species, given in the Crochard edition of the Animal Kingdom (Ins. pl. 16. f. 2 *a*), is very incorrect, being apparently reversed. The dentition of the female is almost identical with that of the male. In the allied bat-winged African species, *Megacephala 4-signata*, Dej., from Senegal, the toothing of the mandibles is similarly arranged, but the two teeth in the middle of the inner margin, in both sexes, are broad and obliquely truncate. In the male of *M. euphratica* (which has recently been observed to extend from Spain to India), the teeth are nearly as in *M. senegalensis*, except that the subapical tooth of the left mandible is considerably smaller. But in the species lately received from the north-west of Australasia (*M. Australasiæ*, Hope), we find a different arrangement as well as number in the teeth, the right mandible having three teeth in the middle of the inner margin (exclusive of the small tooth* at the base of the upper side of the large compound basal tooth), the upper one small, the middle one very small, and lower one large, all being acute. The left mandible has also three teeth in the same position,—the upper one very small, and the middle and lower one large and nearly equal in size.

On turning to the New-World species of the genus, we find four variations in the dentition of the mandibles; the group of pale species typified by *M. æquinoctialis*, Dej. (*bifaseiata*, Brullé), corresponds almost identically in the dentition of both sexes with the old type (*M. senegalensis*), as described above, the right mandible having two equal-sized large acute teeth in the middle of the inner margin, and the left one also two, the upper one being very small. For this group I have proposed the subgeneric name of *Ammosia*, in allusion to their habits, which differ materially from those of the other species.

A black-coloured species from South America (*M. sepulchralis*, Fabr., *M. variolosa*, Dej.) differs from the *Ammosiæ* in the left mandible, while the inner margin has only one tooth in the middle, of considerable size, and exhibiting on its *under* side a minute tooth, being all that remains of the large middle tooth of the left mandible of the *Ammosiæ*. This species is the type of Mr. Hope's subgenus *Anaira*.

Another very fine Brazilian species (*M. testudinea*, Klug) differs in the dentition of the sexes in a more striking manner than any of

* This small tooth exists in all the species, and in both sexes; and as it appears to form part of the great basal tooth, I have omitted noticing it in the descriptions given in this paper.

the preceding. The right mandible of the male is long and sickle-shaped, with a small tooth obliquely truncated below the middle of the inner margin, and between this and the tip of the jaw is a minute acute tooth. The left mandible has two teeth on the inner margin above the middle, the lower one broad and acute, but rather obliquely truncate, whilst the upper one is very small. The right mandible of the female, on the contrary, has two very large equal-sized teeth in the middle of the inner margin, whereas the left jaw in this sex is quite similar to that of the male.

There still remains a numerous group of American species (the type of which is *Cic. Carolina*, Linn.), which differ from the rest of their continental brethren in possessing three teeth in the middle of the inner margin of each jaw, thus resembling the Australian species above noticed, and hence I proposed the name of *Tetracha*, or four-toothed, for this group, counting the acute apical portion of the mandible as a fourth tooth. In general, in both sexes, the tooth next below the apex of the jaw is equal in size to, or even larger than, the apical part or tooth itself (thus differing from the Australasian species), and the middle of the three teeth is smaller than the rest; but in the left mandible in the males the tooth below the apical tooth is even still larger, whilst the middle tooth is much smaller, and the lower tooth is quite minute. In the female, on the contrary, the middle one of the three teeth of the inner margin is rather larger than the upper one (which is only of a moderate size), and the lower one is small.

From these particulars (united with the peculiarities of colouring, geographical range and habits of the species) we are enabled to propose well-founded subgenera, a task which has hitherto been considered hopeless in the genera of *Cicindelidæ*. The Old-World species thus seem to form only one group, divisible however into still smaller sections from the presence or absence of wings, and form and colouring of the elytra; the Australian species stands alone; and the New-World species constitute the four following subgenera:—

Ammosia, Westw. Type, *M. bifasciata*, Brullé.

———, Westw. Type, *M. testudinea*, Klug.

Anaira, Hope. Type, *M. sepulchralis*, Fabr.

Tetracha, Westw. Type, *M. Carolina*, Linn.

BOTANICAL SOCIETY OF EDINBURGH.

July 14, 1853.—Prof. Balfour, President, in the Chair.

The following papers were read:—

1. "Experiments on the Dyeing Properties of the Lichens," by W. Lauder Lindsay, M.D.

2. "On the Cryptogamic Plants of the neighbourhood of St. Andrews," by Mr. Alexander O. Black. The author stated that a residence in St. Andrews during the last eighteen months, had given him

an opportunity of investigating the vegetation of a part of our island, hitherto but little explored by botanists. He had found in all—

Equiseta	11	species and varieties.
Filices	32	„ „
Lycopodia	5	„ „
Musci	170	„ „

3. "Remarks on the Hardiness of certain Coniferæ, as shown by the effects of the past winter," by Mr. W. W. Evans.

4. "Notice of the production of Cones in 1851 on *Pinus Lambertiana*," by A. G. Spiers, Esq. The tree on which the cones were produced was stated to be about 23 feet in height; the cones contained perfect seeds, from which young plants have been raised.

Mr. M'Nab stated that several plants of *Abies Morinda* were fruiting this season in different situations. He mentioned that all these plants had grown in the Botanic Garden, and had been transplanted last year. The large plants of the same pine which had not been transplanted showed no symptoms of flowering.

5. "Measurement of Trees in Gurhwal and Kemaon in 1852," by Mr. John Strachey, C.S.

6. "Notice of the Osseous legumen of the *Hymenæa courbaril*," by Dr. Seller.

7. "On the rarer plants found in the neighbourhood of Ripon," by Mr. James B. Davies.

8. "On *Melampyrum montanum*, Johnst.," by Daniel Oliver, jun., Esq., F.L.S. "This plant, as described in the Berwickshire Flora, and mentioned in Babington's 'Manual' as a variety of *M. pratense*, I am induced to believe has been founded by Dr. Johnston on an examination of an insufficient series of examples of more or less distinct forms of *Melampyrum*.

"Last year I described in the 'Phytologist,' a plant which I called *M. pratense* var. *ericetorum*, and in the same communication hinted that its smaller forms might be identical with the *M. montanum*.

"I am rather strengthened in this opinion by a series of specimens which I collected last month near the Wall-town Crags, Northumberland. The floral leaves (bracts) are in some of the larger instances of the plant, ovate-lanceolate or almost ovate at the base, and deeply toothed, while the smaller ones accord more nearly with *M. montanum*."

MISCELLANEOUS.

On the Movements of the Blood in the Pulmonary Arachnida. By E. Blanchard.

In the circulation of these animals there is a much more complicated mechanism than has ever been supposed. Although the venous blood is not contained in tubes capable of isolation by dissection, it is none the less confined to a particular course.

If a very small opening be made into the heart of a living Scorpion,

and through this a coloured fluid be introduced into the circulation, the heart drives this liquid to the extremities of the finest arteries. Arrived at the last ramifications, the blood certainly slackens in its progress whilst passing through the capillary network. This network, which has not yet been pointed out in the Articulata, exists under the teguments and between the various layers of muscles in the connective tissue; it consists of distinctly circumscribed canals lined with a thin epithelium. Thence the blood is received by the venous canals.

These are only canals and sometimes sinuses and not tubes; but they are always lined with a membrane, which it is frequently not difficult to detach from the surrounding tissues. There are no valvules to prevent the return of the blood. Nevertheless the blood always follows a determinate course, and in fact the disposition of the muscles favours the passage of the fluid in one direction, but presents an obstacle, sometimes absolutely insurmountable, to its passage in the other direction.

In injecting a coloured fluid into the abdominal cavity, it is seen to penetrate readily into most of the spaces occupied by the venous blood, whilst it does not enter the venous canals of the feet or other appendages. A resistance is here presented which is not overcome by considerable pressure; the flexor and extensor muscles of the legs approaching at their points of attachment close the passage from within outwards. It will be readily understood, in fact, that without some particular arrangement, the blood, existing in abundance in the thoracic cavity, would always have a tendency to fall back in the venous canals of the extremities.

The legs are more or less exposed to be broken in the Arachnida. These fractures always take place at the articulations, and the animal does not suffer much from them. A little drop of blood may form at the extremity of the broken limb, but the contraction of the muscles closes the artery, and the venous canal is so disposed that the normal course of the blood is never interrupted for an instant. At the extremity of each joint of the legs the large venous canal is curved back so as to take up all the blood coming from the lesser canals. This arrangement completely explains why when half the leg of a Scorpion or Spider is torn off the blood escapes from the detached portion, and not from that which remains attached to the body.

The venous blood collected from various parts of the body arrives at last in canals situated at the sides and lower part of the abdomen, whence it passes to the respiratory organs. The principal venous canals are lodged in the interstices of the segments, and are formed by a fold of the internal membrane. In the Scorpions, the venous canals of the caudiform portion of the abdomen and those of the feet consist of gutters which show themselves externally as so many ridges.

In the Arachnida, nearly as in the Crustacea, the blood returns to the heart from the respiratory organs by means of vessels passing up along the sides of the abdomen and opening into the pericardiac cavity. This is effected in the following manner.

The respiratory organs are covered by a tolerably thick membrane, which is contracted between each of them, and prolonged in front and behind in the form of a wide vessel receiving the venous blood. Each pulmonary sac is alternately raised or depressed by a double or triple ligament, which rises perpendicularly and is attached to the pericardium. When a portion of the heart is exposed, it is seen that its pulsations act upon the contractile ligaments, causing a pressure of the pulmonary sacs, which forces the blood to rise in the pneumocardiac vessels. This movement is aided by muscular pillars attached to the upper and lower walls of the abdomen.

From all these facts we must conclude, that in the pulmonary Arachnida the venous blood circulates for a great portion of its course in distinctly circumscribed canals; that it passes into the abdominal cavity as into a vast sinus, so as to penetrate thence into the respiratory organs, whence it rises into the heart by means of a particular mechanism. These facts lead us naturally to the conclusion that analogous arrangements should be sought for in Crustacea and Insects.—*Comptes Rendus*, June 20, 1853, p. 1079.

THE TIBETAN BADGER OF HODGSON.

Mr. Hodgson having sent to the India House a specimen with its skull of his *Taxidea leucurus* (Journ. Asiatic Soc. Bengal, xvi. 763. 1847), I have compared the skull with that of the various Badgers in the Museum collection. I find all the Old-World Badgers (*Meles*) have a moderate-sized triangular flesh tooth, and a very large four-sided oblong tuberculous grinder in the upper jaw, which is rather longer than broad, and the skull is rounded behind. The nose of the Tibetan Badger or Tumpha, *Meles leucurus*, is rather more tapering and more compressed than that of the European Badger (*Meles Taxus*), which it most resembles. The Japanese Badger (*Meles anakuma*) differs from both in having a much shorter skull and a short, rather broad nose.

The American Badgers (*Taxidæ*, Waterhouse) have a very large triangular flesh tooth, and an equally triangular tubercular grinder in the upper jaw not exceeding the flesh tooth in size. The skull is also much broader, more depressed and truncated behind. Of this genus I only know a single species, *T. Labradoria*.—J. E. Gray.

Note on the Germination of the Spores of the Uredines.

By L. R. Tulasne.

Some years since I made known* the origin and structure of the organs known as the spores of these plants. I then showed that these bodies, like the pollen grains of phanerogamous vegetables, are furnished with a variable number of pores through which tubular filaments afterwards pass, analogous, at least in appearance, with those which are the first result of the germination of the spore of a Fungus.

I have since indicated† the *Æcidiolum exanthematum*, Ung., as a

* Ann. des Sci. Nat. 3rd série, t. vii.

† Comptes Rendus, xxxii. March 31, 1851.

peculiar organ of the Uredines, and that its frequency amongst their sori or fertile groups, its relations of position, and its early appearance authorise us in comparing it with the spermogonia of other Fungi, so that the sexuality of the Uredines was not less probable than that of the other families of the same order.

Fresh investigations have shown me that the germ-filaments of the spores do not all continue in the state of simplicity and continuity in which I formerly saw them, and that perhaps they may constitute the rudiments of the *mycelium*.

Thus having sown perfectly ripe spores of *Æcidium Euphorbiæ sylvestris*, DeC., their germ-filaments became less elongated than in my previous experiments, made at a different time of the year, and instead of remaining continuous, they divided by means of transverse septa into four or six cells of unequal size; then these cells, and especially the superior ones, each produced a short lateral appendage (*spicule*), which soon bore an obovate and slightly oblique utricle. These utricles were the last vegetative effort of these spores; they became free and then continue a separate existence, which was indicated by the production of very slender filaments. After the isolation of these bodies, the spore and the tube from which they were formed become exhausted and destroyed, so that this tube or filament represents a sort of *promycelium*, an intermediate vegetation between the primary spore and the utricles, which are either secondary spores, or perhaps the only true spores, and the real producers of the true *mycelium*.

The same facts may be observed in the *Pucciniæ*, the bilocular fruits of which can commence vegetation without quitting the plant which has supported them. In *Puccinia graminis*, Pers., I have seen the tubes arising from these fruits acquire two or three times their length, divide into cells like the germ-filaments of the preceding *Æcidium*, and like these give rise lastly to nearly reniform spores which soon germinated.

The vegetation of the fruit of *Phragmidium incrassatum*, Link., does not differ from that of the *Pucciniæ*. The spores produced are more globular than those of the above-mentioned Fungi.

The *Podisomata* (*P. juniperi communis*, Fr., and *P. fuscum*, Cord.) are Uredines by their parasitic existence and their mode of fructification, whilst in their general appearance and consistence they resemble the *Tremellæ*. Their bilocular fruits (*sporidia*, auct.) can emit as many as eight tubes from their middle; these are crossed and superposed two and two, clothe the Fungus as with a sort of velvet, and each produce several obovate *spores*, an immense abundance of which may be collected as readily as of those of the *Agarici* or *Tremellæ*.

In several Uredines which I have studied, such as *Uredo Rosæ*, Pers., *U. suaveolens*, Pers., *Æcidium Tussilaginis*, Pers., *Æ. crassum*, Pers., and some others, the tubular filaments which arise from the fruits are capable of more or less ramification, so as to resemble the true *mycelium* of Fungi still more closely.

As regards the spermogonia of the Uredines, I will add that they are organs the structure of which varies extremely little. They all

eject, in the form of viscous drops or short cirrhi, an orange substance which is very aromatic, and consists of very thin, ovoid corpuscles (*spermatia*). It is to these alone that the agreeable odour of the *Uredo suaveolens* and many other Uredines is due. The spermatia are produced at the apices of filiform basidia.

The *Ustilagines*, which are very nearly allied to the Uredines, present certain peculiarities in the vegetation of their reproductive bodies. The oblong cell, which is produced from the spores of *Ustilago antherarum*, Tul., becoming soon detached to live independently*, must apparently be compared to the secondary spores of *Æcidium*, *Puccinia*, and other Uredines above described. In *Ustilago receptaculorum*, Fr., utricles, doubtless analogous with these secondary spores, are produced on an imperfectly developed *promycelium*, composed only of a few cells, but which resembles that of *Æcidium Euphorbiæ sylvestris*.—*Comptes Rendus*, June 20, 1853, p. 1093.

METEOROLOGICAL OBSERVATIONS FOR JULY 1853.

Chiswick.—July 1. Showery. 2. Cloudy. 3. Cloudy and fine. 4. Very fine. 5. Overcast: fine: clear. 6. Overcast and fine. 7. Uniform haze: sultry: much lightning, with thunder and rain at night. 8. Cloudy: lightning at night. 9. Rain: cloudy. 10. Cloudy: clear. 11. Densely overcast: cloudy and fine. 12. Very fine. 13. Very fine: slight haze: very heavy rain at night. 14. Constant rain. 15. Heavy showers. 16. Showery. 17. Cloudy and fine: very clear. 18. Heavy showers. 19. Showery: clear. 20. Uniform haze: very fine. 21. Rain: cloudy. 22. Overcast: slight rain. 23. Very fine. 24. Cloudy. 25. Very fine: rain at night. 26. Cloudy. 27. Cloudy and fine: thunder, lightning and very heavy rain at night. 28. Rain: cloudy: showery. 29. Fine: rain. 30. Fine: boisterous: clear at night. 31. Clear: cloudy: overcast.

Mean temperature of the month	61°·99
Mean temperature of July 1852	67 ·61
Mean temperature of July for the last twenty-seven years	63 ·22
Average amount of rain in July	2·29 inches.

Boston.—July 1. Fine: rain P.M. 2. Fine. 3. Cloudy. 4. Cloudy. 5. Cloudy: rain P.M. 6—8. Cloudy. 9. Cloudy: rain, thunder and lightning A.M. 10. Cloudy. 11. Cloudy: rain A.M. 12, 13. Fine. 14. Rain: rain A.M. and P.M. 15. Cloudy. 16, 17. Cloudy: rain A.M. 18. Cloudy: rain A.M. and P.M. 19. Cloudy. 20. Cloudy: rain A.M. and P.M. 21. Cloudy. 22. Fine. 23. Cloudy. 24, 25. Fine. 26. Rain: rain A.M. and P.M. 27. Cloudy. 28. Cloudy: rain A.M. 29. Fine. 30. Cloudy: rain A.M. 31. Cloudy: rain P.M.

Sandwick Manse, Orkney.—July 1. Bright A.M.: drops P.M. 2. Showers A.M.: fair P.M. 3. Rain A.M.: fair P.M. 4, 5. Cloudy A.M.: rain P.M. 6. Bright A.M.: cloudy P.M. 7. Drops A.M.: cloudy P.M. 8. Bright A.M.: cloudy P.M. 9. Clear A.M.: cloudy P.M. 10, 11. Bright A.M.: cloudy P.M. 12. Bright A.M.: clear P.M. 13. Clear A.M.: cloudy P.M. 14. Clear A.M.: rain P.M. 15. Showers A.M.: cloudy P.M. 16—18. Bright A.M.: clear P.M. 19. Bright, fine A.M.: clear P.M. 20. Rain A.M. and P.M. 21. Damp A.M. and P.M. 22. Damp A.M.: clear P.M. 23. Clear, fine A.M.: cloudy P.M. 24. Rain A.M.: clear P.M. 25. Bright A.M.: clear P.M. 26. Showers A.M.: damp P.M. 27. Showers A.M. and P.M. 28. Fine A.M.: clear P.M. 29. Drizzle A.M.: clear P.M. 30. Bright A.M.: fair P.M. 31. Bright A.M.: fine P.M.

Mean temperature of July for twenty-six previous years	54°·93
Mean temperature of July 1852	61 ·36
Mean temperature of this month	58 ·15
Average quantity of rain in July for seven previous years	2·69 inches.

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* Ann. des Sci. Nat. 3rd série, t. vii.

Meteorological Observations made by Mr. Thompson *at the Garden of the Horticultural Society at* Chiswick, *near London; by* Mr. Veall, *at* Boston; *and by the* Rev. C. Clouston, *at Sandwick Manse,* Orkney.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston. 8½ a.m.	Orkney, Sandwick.		Chiswick.		Boston. 8½ a.m.	Orkney, Sandwick.		Chiswick. 1 p.m.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1853. July.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
1.	29·773	29·700	29·24	29·48	29·62	70	46	60	56	53	sw.	sw.	wnw.	·22	·12	.....
2.	30·156	29·977	29·48	29·84	30·01	70	48	61·5	51½	50	w.	nw.	w.	.....	·03	·23
3.	30·237	30·163	29·72	29·89	29·78	70	49	62	55½	54	w.	w.	wsw.	.....	.....	.....
4.	30·153	30·040	29·48	29·78	29·69	73	53	67·5	57½	55	sw.	wsw.	se.	.....	.....	·10
5.	30·019	29·924	29·46	29·68	29·40	74	55	67·5	59	57	sw.	sw.	sw.	.....	.....	·13
6.	29·940	29·886	29·37	29·63	29·66	77	58	69·5	57½	56	sw.	ssw.	sw.	.....	·09	·23
7.	29·919	29·809	29·40	29·66	29·91	84	63	70	56½	51½	se.	w.	wnw.	·14	.....	.....
8.	29·960	29·896	29·43	30·05	30·14	79	59	65	60	54	ne.	ne.	s.	·14	.....	.....
9.	29·925	29·869	29·50	30·07	30·02	81	57	61	62	55	s.	ne.	calm	·05	.....	.....
10.	29·906	29·425	29·38	29·92	29·75	70	47	67	62	58	nw.	wnw.	se.	·01	·38	.....
11.	30·128	29·979	29·46	29·74	29·82	72	46	70	61	56	sw.	ssw.	w.	.....	.....	·04
12.	30·017	29·944	29·52	29·90	29·94	76	47	64	57	56	sw.	wnw.	calm	.....	·02	.....
☽ 13.	29·861	29·422	29·37	29·89	29·84	72	55	70	62	58	e.	se.	se.	·92	.....	.....
14.	29·297	29·176	28·56	29·75	29·50	61	49	63	61½	54	sw.	sw.	nnw.	·64	1·06	.....
15.	29·576	29·364	28·84	29·40	29·36	66	48	61·5	61	58	sw.	wsw.	e.	·34	·57	·16
16.	29·606	29·578	29·14	29·34	29·46	66	51	63·5	63	57	sw.	ssw.	se.	·26	.....	·01
17.	29·884	29·825	29·35	29·57	29·66	69	47	65	64	58	sw.	sw.	e.	.....	·42	.....
18.	29·902	29·813	29·40	29·73	29·88	66	52	62·5	65½	58	sw.	sw.	calm	·35	·06	.....
19.	29·929	29·904	29·42	29·92	29·99	71	48	62	65	60	sw.	nw.	calm	·02	·11	.....
○ 20.	29·987	29·859	29·47	29·70	29·27	71	55	67·5	65	57	sw.	sw.	sw.	.....	·04	.....
21.	29·831	29·750	29·20	29·56	29·54	70	58	70	63	60	sw.	s.	sw.	·06	·17	·13
22.	29·765	29·610	29·46	29·50	29·65	70	48	61	64	61	s.	sw.	w.	·01	.....	.....
23.	29·972	29·879	29·24	29·70	29·78	76	53	64	64	59	sw.	ssw.	se.	.....	.....	.....
24.	29·829	29·719	29·26	29·34	29·32	72	47	63·5	59	59	sw.	sw.	se.	.....	.....	·23
25.	29·783	29·776	29·26	29·25	29·40	73	52	63	61	58	sw.	sw.	se.	·04	.....	.....
26.	29·831	29·798	29·23	29·26	29·40	68	56	64	63	55	sw.	sw.	w.	.....	.....	.....
☾ 27.	29·947	29·854	29·43	29·46	29·62	73	57	64·5	57	54	s.	sw.	sw.	·98	·20	·08
28.	29·795	29·770	29·27	29·70	29·70	72	53	64	59	53	w.	nw.	w.	·10	.....	.....
29.	29·894	29·810	29·38	29·57	29·32	71	56	61	63	52	sw.	wsw.	w.	·03	·02	·10
30.	29·834	29·742	29·20	29·28	29·45	68	48	61	58	55	w.	sw.	w.	.....	.....	.....
31.	29·984	29·919	29·47	29·60	29·71	71	58	61	57½	53	sw.	w.	calm	.....	·06	·13
Mean.	29·891	29·780	29·33	29·650	29·664	71·67	52·22	64·4	60·35	55·95				4·31	3·35	1·57

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

No. 70. OCTOBER 1853.

XXIII.—*On some new species of* Trigonia *from the Inferior Oolite of the Cotteswolds, with preliminary Remarks upon that Genus.* By John Lycett, Esq.*

[With a Plate.]

"Not only by their numbers, but still more by the richness of their specific divisions, by the peculiar prominence of individualization, do the species of the remarkable genus *Trigonia* attain their maximum point in the lower chalk."—L. von Buch, *Betrachtungen über die Verbreitung und die Grenzen der Kreide Bildungen.* Bonn, 1849.

Trigonia and *Pholadomya* are the two organic forms which pre-eminently serve to impress a distinctive character upon the Testacea of the Oolite rocks in whatever country they are discovered, and accordingly from the time when fossil shells were regarded as mere freaks of nature, we find that authors depicted their *Hippocephaloides* and *Bucardites*. But conspicuous as is the position which *Trigonia* holds throughout the Oolites, the quotation above chosen, and the passages which immediately follow, are not the less true and worthy of notice; they evince the strong impression made upon the mind of a distinguished and veteran palæontologist by the remarkable prominence which the genus *Trigonia* holds amongst the Cretaceous Conchifera, both in its numbers and world-wide distribution, a prominence which appears not the less remarkable when we remember that the leading sectional oolitic forms of the genus had already nearly disappeared, and that a little higher in the series even the cretaceous forms exhibit a rapid diminution, until in the upper chalk a trifling remnant alone remains to indicate the forthcoming extinction of the fossil *Trigoniæ*, a loss which is not the

* Read to the Cotteswold Naturalists' Club, July 19, 1853.

less strongly felt upon a contemplation of the altered, and in some measure degenerated characters of the living species. But if the attributes claimed for the genus at the æra which immediately precedes the extinction of the Cretaceous species are well founded, it will, I think, appear equally evident that at its primal æra in the earlier portion of the Oolitic system the genus had already acquired that prominence amongst the Testacea which Von Buch has so vividly described, and that the forms, dimensions, and ornamentations of the species were scarcely less characteristic and varied. Upon numbering the entire recorded species of *Trigonia*, it will be found that about two-thirds are proper to the Oolitic rocks; and although some little abatement must be made, for instances in which young individuals, varieties, or mere casts have been erected into distinct species, the predominance of Oolitic forms will remain, inasmuch as the Cretaceous species are not exempt from similar errors of augmentation. The inadequate manner in which the Inferior Oolite *Trigoniæ* have been illustrated, will appear, when it is stated that of the sixteen species recorded in the present paper, four only will be found illustrated in the range of English literature; a fifth occurs in the 'Mémoire sur les Trigonées' of Agassiz, and two others are on the eve of being published in a 'Monograph of the Palæontographical Society,' leaving upwards of nine species unfigured, a number which will be admitted to be remarkable when we remember that M. D'Orbigny has only enumerated seven in his 'Prodrome de Paléontologie' for the Terrain Bajocien of the whole of France, and M. Agassiz twelve from the entire lower Oolite rocks of Germany, France and Switzerland. The present examination of Inferior Oolite species has been suggested by the frequent occurrence in collections of *Trigonia costata, clavellata* and *angulata*, or of shells bearing those names, pertaining to nearly the entire series of the Oolitic rocks of England and France; the aspect of these shells is so varied and dissimilar, that they agree with each other and with the typical forms of those species only, inasmuch as the first portion is costated, the second clavellated, and the remainder have their costæ bent to form an angle.

M. Agassiz, in his valuable memoir on *Trigonia*, arranged the species into upwards of eight sections, some of which appear to be separated by distinctions so transitive that it is scarcely possible to apply them to a large number of specimens, except in an arbitrary and unsatisfactory manner; a more simple arrangement here proposed will probably answer every practical purpose, and has at least the advantage of being more readily understood and applied; the genus will thus form six sections, of which one, the Pectines, is recent only; the five fossil sections consisting of

the Costatæ, the Clavellatæ, the Quadratæ, the Scabræ, and the Glabræ. The *Costatæ* have a figure more arched than the other sectional forms; they have smooth regular longitudinal ribs, which are separated from the posterior slope or area by a carina more or less prominent, but which, with advance of age, often becomes nearly obliterated; this is the *marginal carina*; the area has transverse striations which are frequently decussated by longitudinal plications, and by one or two, more prominent than the others, that which bounds the area posteriorly being the *inner carina*; should a third carina be present between the two others, it is the *median carina*; the lanceolate space posterior to the ligament is always plicated or reticulated.

The *Costatæ* are remarkably prominent in the lower and middle Oolite rocks; in the upper Oolites and lower portion of the Cretaceous series they diminish and almost disappear. The *Clavellatæ* accompany the *Costatæ* in their stratigraphical distribution; in this section I would include the *Clavellatæ*, the *Undulatæ*, and the *Scaphoides* of Agassiz, all of which have their costæ divided into tubercles, serrations, or irregular varices which are disposed in rows, either concentric, oblique or excentric; sometimes they are bent to form an angle after the manner of the *Goniomyæ*; the links which connect the one with the other of these features are too transitive to allow of any clear sectional divisions when they are applied to a large number of species, neither will the differences of form afford any more certain guide. In the *Clavellatæ*, as in the former sections, a carina more or less distinct separates the area from the tuberculated portion of the surface; the area is transversely striated and is never large; the lanceolate post-ligamental space is smooth, except in certain subcretaceous forms, which have the space strongly costated, as in the contemporaneous *Scabræ*, to which they form a passage; these are the *T. sulcataria*, Lam., *T. muricata*, Goldf., and *T. Lusitanica*, Sharpe.

The *Quadratæ* have the figure rendered subquadrate by the largeness of the area, the upper border of which is nearly horizontal; its surface is flattened, and sometimes constitutes the larger half up the shell; there is no marginal carina, neither is there any clear line of separation between the area and the tuberculated portion of the surface; the *Quadratæ* are fewer than the *Clavellatæ*, which they seem to replace in the Cretaceous and upper portion of the Oolitic system; *Trigonia nodosa*, Sow., is a well-known example. The *Scabræ* constitute a fourth and very natural section, which are distinguished not less by their figure than by the beauty and variety of their ornamentation; their figure indicates a change from the usual figure of the genus; it is crescentic rather than trigonal; the oblique costæ are elevated

and serrated; they are continued across the depressed area, the separating carina (marginal) being replaced only by a smooth groove. The stratigraphical distribution of the *Scabræ* is equally characteristic; they are exclusively Cretaceous, and seem to replace the *Costatæ* of the Oolitic rocks; *Trigonia alæformis* and *spinosa* are examples. The fifth section, or *Glabræ*, are destitute of costa, rows of tubercles or of carinæ upon the area; their sides have large longitudinal plications, and are nearly smooth; *Trigonia gibbosa* and *affinis* are examples: this section, of which few species are known, has not occurred beneath the upper division of the Oolitic rocks. The sixth section, or *Pectines*, is represented by the living species of our Australasian seas, in which both the form and ornaments of the surface differ materially from those of the fossil sections; the radiating crenulated costæ and toothed edges of the valves remind us of the *Limæ* and *Pectines*; the very partial flattening of the posterior slope and general figure nearly resembles *Cardium*, but the internal characters have nothing peculiar.

In tracing the vertical range of the species throughout the Oolitic rocks, it will be found that the facts coincide with others which have been recorded respecting the range of species pertaining to the other leading genera of Conchifera; it is rare that a species ranges beyond a single formation; and when its existence was further extended, it occurs usually in the newer formation, as a variety only, and bearing a physiognomy readily distinguished from that of the typical form. The aspect of the genus seems to have undergone a very gradual but continuous change throughout the secondary formations, by which the sectional forms of the lower Oolites were modified in the upper Oolites, and finally disappeared as the *Quadratæ* and *Scabræ* of the Cretaceous rocks acquired prominence; finally, between the latter and the recent *Pectines*, there occurs a chasm not less zoological than stratigraphical, in which we lose the links by which probably they were connected.

In the discrimination of species, it is of importance to have correct ideas of the surface-markings which distinguish their young condition. In the *Clavellatæ* generally, the young shells have their concentric costæ continued across the area; the costæ are slightly tumid and projecting when they cross the position of the marginal carina: in several instances the young of this section have smooth undivided costæ, and such species as in the adult state have their costæ forming an angle or undulation, do not exhibit any trace of such a feature until five or more costæ have been formed. But if in the rudimentary condition we are often unable to distinguish forms which subsequently become widely separated, the individuals of a species are in their imma-

ture stage all alike; they exhibit no traces of that law which is afterwards developed to form varieties of a species. A common feature observable in the *Clavellatæ* and *Quadratæ* which tends to mask the species, consists in a confused or reticulated disposition of the tubercles, which no longer form regular concentric or curved rows; the tubercles also become irregular in size, or they are partially flattened and confluent in the rows; it is not clear to what causes are to be attributed this unequal secretion of shell by the mantle at the lower border; it is however quite distinct from another and final change observable in aged shells, when the mantle ceases altogether to secrete ornaments upon the surface; in the latter case a change occurs (sometimes sudden), in which the carinæ upon the area, and the tubercles upon the sides of the shell simultaneously disappear, the last-formed portion of the surface being altogether destitute of ornament.

The mineral character of the beds in which *Trigonia* occurs is very various; clays, argillaceous limestones, chalk, calcareous oolitic freestone, and shelly oolitic drift equally contain it, but the latter kind of deposit does not seem to have been favourable for its development; for although specimens are abundant the size is dwarfed, and by far the larger number perished in the earlier stages of their growth.

In England the oldest stratum which contains *Trigonia* is the Lias of Yorkshire, which produces the *T. literata*. Phillips records it in the lower, and Williamson in the upper Lias, but the same formation has not furnished a single example of the genus throughout the middle and west of England; in Switzerland and Germany the upper Lias has five species, none of which have been identified in England. In the Cotteswold Hills, *Trigonia* is first found in the beds of ferruginous oolite which immediately overlie the sands at the base of the formation, and which abound with *Ammonites*, *Belemnites* and *Nautili*, but the *Trigoniæ* are not numerous, and are only of three species; in the freestone beds higher in the series, and which are so largely developed in Gloucestershire, some local deposits have many species of *Trigonia*, but the genus does not acquire any particular prominence; it is only upon reaching the ragstones of the upper division of the formation that we find *Trigonia* in abundance; there it is associated with a large assemblage of bivalve mollusks, and less commonly with Echinodermata and Corals, but in either case the impressions of *Trigonia* often constitute a large proportion of the entire mass of the rock.

The Inferior Oolite, in common with the middle and lower Oolitic rocks generally, contains, according to the present arrangement, two sections only of the genus *Trigonia*.

In the following descriptions of species, the references to such

as have been before figured and described are given as concisely as possible.

COSTATÆ.

Trigonia costata, Lam. Var. 1. *costata*. Var. 2. *multicosta*. Var. 3. *pulla*. Var. 4. *sculpta*.
T. costatula, Lyc.
T. exigua, Lyc.
T. tenuicosta, Lyc.
T. hemisphærica, Lyc.

CLAVELLATÆ.

T. striata, Sow.
T. duplicata, Sow.
T. angulata, Sow.
T. signata, Ag.
T. tuberculosa, Lyc.
T. v.-costata, Lyc.
T. clavo-costata, Lyc.
T. Phillipsi, Mor. & Lyc. *var.*
T. subglobosa, Mor. & Lyc.
T. gemmata, Lyc.
T. decorata, Lyc.

Trigonia tenuicosta, Lycett, n. sp. Pl. XI. fig. 4 *a*.

Shell subhemispherical, moderately large, the anterior and inferior borders rounded, the posterior border slightly concave; umbones pointed, prominent and recurved; costæ very numerous, not much elevated, closely arranged, gracefully curved and almost united to the marginal carina; area very large, its surface forms a considerable angle with the costated surface of the shell; it has three carinæ, the median and inner of which are small but distinct, and finely striated throughout their length; the marginal carina is delicate, striated, rather acute and very much curved; the spaces between the carinæ are very finely reticulated, the lanceolate space between the inner carinæ is large and very finely reticulated.

The great convexity of the valves and incurved figure of the umbones produces a considerable curvature in the marginal carina, and the costated portion of the shell near to the umbones is very narrow; the length of the marginal carina is somewhat greater than the diameter of the shell at right angles to it. From *Trigonia costata* it is distinguished by the more acute recurved apex, by the small and finely striated marginal carina, by the delicate and finely striated median and inner carinæ; the costæ are much more numerous, and are scarcely separated from the

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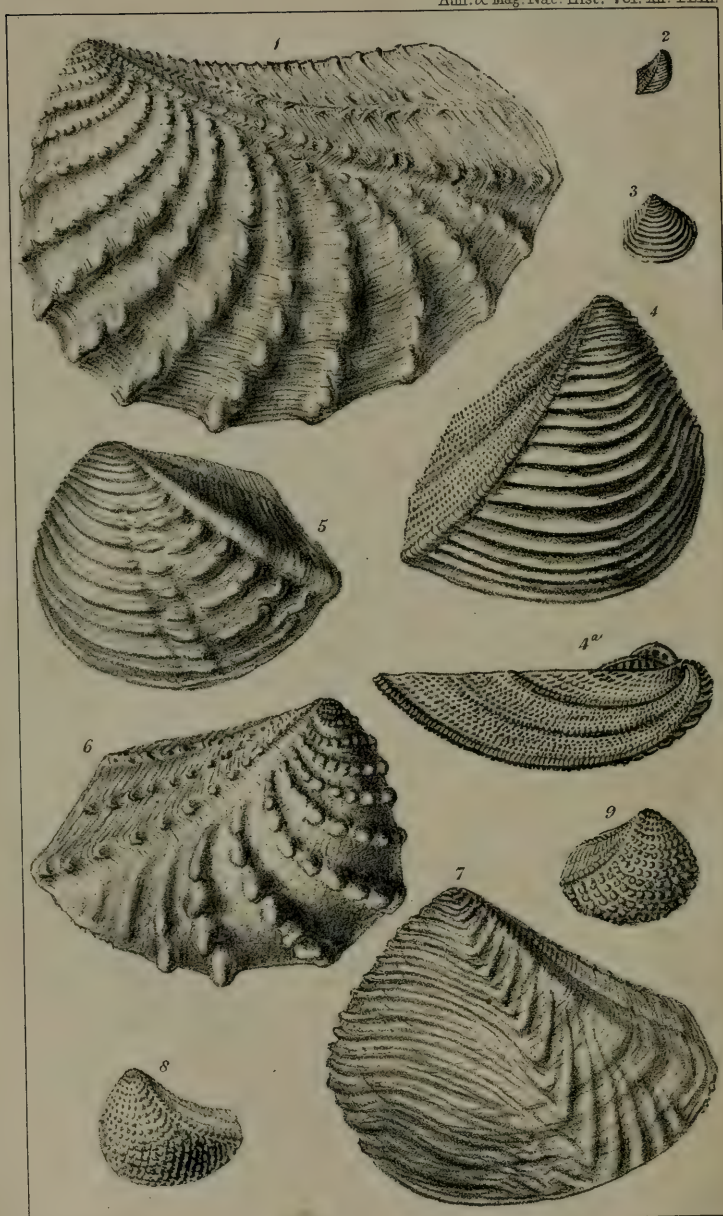

J. De. C. Sowerby del.t

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marginal carina; the entire form is smaller and unlike *T. costata*; the area is alike in both the valves.

It is somewhat rare; all the examples have been obtained in the upper division of the Inferior Oolite.

Professor Buckman has obtained it near Cheltenham; my own specimens are from the Gryphite grit of Rodborough Hill near Stroud.

Trigonia hemisphærica, Lycett, n. s. Pl. XI. fig. 2.

Shell small, its length not exceeding 3 lines, very much arched, so that the diameter through both the valves slightly exceeds the length; the umbones are scarcely recurved, acute, contiguous; the area is large, flattened, forming a considerable angle with the other portion of the shell; it has numerous fine longitudinal plications faintly traced, there is no median carina, and the inner carina is very small; the marginal carina is acute, elevated and finely serrated; the other surface has numerous closely arranged longitudinal costæ, which are united to the marginal carina.

The large number of costæ and the characters of the area induce me to regard this as the adult condition of the species, notwithstanding the small dimensions.

A single specimen is my authority; it is from the bed of hard pale calcareous mudstone, a local deposit which in the Nailsworth valley replaces the bed of Oolite marl and abounds with *Nerinæa*.

Trigonia costatula, Lycett. Pl. XI. fig. 5.

Trigonia costatula, Lycett in Ann. & Mag. Nat. Hist. 1850, p. 421.

Shell subtrigonal, convex; umbones mesial, not prominent nor recurved, anterior side produced and rounded, posterior side truncated; area flattened, finely striated transversely, divided longitudinally into two equal portions by a groove and bounded by two low carinæ; the marginal carina is imperfectly serrated, it is of moderate size and but little curved; the inner carina is nearly smooth; the space between the inner carinæ is smooth and very narrow or lanceolate; the costæ are numerous (about 21), moderately prominent and closely arranged; they are but little curved, are separated from the marginal carina by a plain surface, their direction being nearly horizontal or conformable to the inferior border. In the ultimate stage of growth the costæ posteriorly are broken more or less into several portions, which, however, continue to follow the general direction of the costæ. In the immature form the costæ are not separated from the marginal carina, and the area is traversed transversely by an equal number of prominent plications; but these gradually vanish, and the costæ become disunited from the carina, which then becomes

serrated. The truncation at the posterior extremity is so considerable that the breadth of the area at that part is equal to half the entire length of the shell, or to three-fifths of the height; the length of the marginal carina is 20 lines.

The upper portion of the middle division of the Inferior Oolite has furnished the few specimens which have been procured; the locality is Scar Hill near Nailsworth.

Trigonia exigua, Lycett, n. sp. Pl. XI. fig. 3.

Shell small, subtrigonal, depressed; umbones mesial, not recurved, anterior border nearly straight, oblique, posterior border truncated; area moderately large, flattened, transversely ribbed, and having an obscure oblique mesial furrow, no distinct carinæ, the marginal carina being replaced by a series of small nodulous elevations upon the posterior extremities of the costæ. Costæ smooth, curved, closely arranged, rounded, and slightly bent upwards as they approach the area, their number being about fourteen.

The costæ upon the area are smaller and rather more numerous, for an intercalated rib is sometimes added. Specimens vary from 2 to 5 lines in length, the latter dimensions seeming to represent the adult form.

From *T. costatula* it is distinguished by the much smaller dimensions and by the absence of any distinct marginal carina, the costæ being continued over its position upon the area.

Trigonia concinna, Rœmer, Nord. Ool. Nachtrag. p. 35. tab. 19. fig. 21. approximates to our shell in the general figure and disposition of the costæ, but his shell would appear to have greater convexity and a larger area, and the costæ upon the area appear to be as large as those upon the other portion of the surface; it is therefore probably a distinct species.

Our little shell occurs not uncommonly in the shelly freestone of Leckhampton Hill; it has also occurred in the same beds near to Nailsworth.

Trigonia v.-*costata*, Lycett. Pl. XI. fig. 7.

Trigonia v.-*costata*, Lycett in Ann. & Mag. Nat. Hist. 1850, p. 422.

Shell ovately trigonal, moderately convex, anterior and inferior margins rounded, posterior margin straight or slightly concave; umbones obtuse, slightly recurved; area narrow, flattened, its upper portion transversely plicated, its lower portion nearly smooth, divided in its middle by an obliquely longitudinal furrow; marginal and inner carinæ but faintly marked and striated, the inner carina being crossed by several varices. The costæ are very numerous, smooth and regular, they are directed from the

anterior border obliquely downwards and backwards nearly straight to the middle of the shell, and there form acute angles with varices which proceed upwards nearly vertically to the marginal carina; the varices are slightly nodulous, they are fewer and larger than the anterior costæ. The first eight or nine costæ form only curvatures, and are not broken into two portions.

The species which approaches most nearly to the present shell is *T. angulata,* Sow., but the figure of the two is different; the latter shell is more elongated and rostrated, the posterior border is much more concave, the umbones are more recurved, and consequently the marginal carina is more curved and elongated; the costæ are less numerous, less regular, and the varices are larger and more distantly arranged; they form with the costæ rather an undulation than an angle, and are more conspicuously tuberculated.

In the young state the two forms would more nearly resemble each other, but even in that condition the costæ are more closely arranged in *T.* v.-*costata.* Some examples in the British Museum of a *Trigonia* collected by Miss Baker in the ferruginous Oolite of Northampton may be the young condition of the species; to the same species may also be referred some small shells from the Dogger of the Yorkshire coast; these have smooth, straight, oblique costæ, bent at a considerable angle, and have been labelled in collections *T. angulata.* The small *T. tripartita,* Forbes, from the Oolite of the Hebrides, has a certain degree of resemblance to our species, but the varices in that shell are fewer and much larger.

From *T. undulata,* From., our shell is distinguished by the less convex form and absence of large tubercles upon the marginal carina; the arrangement of the costæ is nearly similar, but in our species they are much more numerous.

In the Cotteswolds *T.* v.-*costata* has occurred very rarely in the middle or freestone division near to Stroud, and my friend Dr. Wright has obtained two specimens in the ragstones of the upper division near to Cheltenham.

Trigonia decorata, Lycett, n. sp. Pl. XI. fig. 1.

Shell ovately trigonal, somewhat depressed; umbones obtuse not recurved, anterior and inferior borders rounded, posterior border lengthened and straight; area flattened, striated transversely, ornamented with three faintly traced carinæ, or rather as many lines of closely arranged very small regular tubercles, the inner carina having in addition at its upper part a few irregular transverse plications or varices; there is also a median

divisional sulcus, which passes parallel to the median row of tubercles upon the area. The clavellated portion of the shell has a very numerous series of rows of concentric tubercles; the tubercles are small near to the marginal carina, and become larger towards the middle of the curvature; they are distinct, rounded, closely arranged (15 or 16 being contained in a row), the number of rows being about twenty, the whole of which are distinctly tuberculated; the lines of growth upon the sides of the shell are fine and distinct. The dimensions are equal to the largest examples of the clavellated *Trigoniæ*.

This elegant shell is nearly allied to *T. perlata*, Ag., which is an Oxford clay species; in that shell however the umbones are more recurved, the carinæ have much larger tubercles, and the median carina has in addition a series of transverse varices which are absent in *T. decorata*. It has sometimes been mistaken for *T. clavellata*, but differs from that well-known form in the following particulars.

The Inferior Oolite shell is less elongated, the umbones are not recurved, the posterior border is not concave, the general figure has less convexity, the area is more flattened, and the lanceolate space is much smaller and not striated; the rows of costæ are more numerous; the tubercles are more numerous, more closely arranged and less prominent. Another large clavellated species, the *T. muricata*, Goldf., approaches more nearly to the figure of our shell, but the Portuguese species has the area much more narrow, the costæ are less numerous, but much more elevated, the tubercles being larger and more distantly arranged.

The figure likewise closely agrees with *T. Bronnii*, Ag., from the Terraine à Chailles or Oxford clay; but the ornamentation of our species, both upon the area and the sides of the shell, is more minute and delicate, with more numerous rows of costæ, the carinæ having no distinct elevation as in the species of Agassiz.

Trigonia decorata occurs abundantly in the Trigonia grit throughout the Cotteswolds, but the test is very fragile, and is difficult to detach from the hard matrix. Rodborough Hill near Stroud has produced it in great numbers.

Trigonia gemmata, Lycett, n. sp. Pl. XI. fig. 8.

Shell small, ovately trigonal, excavated and somewhat rostrated posteriorly, rounded anteriorly; umbones obtuse, somewhat recurved, surface moderately convex; area narrow, transversely striated and bounded on each side by a narrow, elevated and striated carina, which is also gracefully curled; costæ numerous, closely arranged, elevated, acute; the upper third of the valves has concentrically curved and finely tuberculated costæ, those

which succeed are directed from the carina obliquely downwards; they are straight, are regularly and densely serrated, the spaces between the costæ forming narrow deep grooves.

T. duplicata, Sow., approaches our shell in the general figure and in the arrangement of the costæ, but the latter costæ of *T. duplicata* are dichotomous and waved, the serrations being irregular; neither of these features are observable in our shell.

It is very rare; the largest specimen is an inch and a quarter in length upon the marginal carina, and an inch in the opposite direction. I have only seen two specimens.

Near Nailsworth, in the freestone beds.

Trigonia tuberculosa, Lycett. Pl. XI. fig. 9.

Trigonia tuberculosa, Lycett in Ann. & Mag. Nat. Hist. 1850, p. 422.

Shell small, depressed, ovately trigonal; umbones recurved, anterior and inferior borders rounded, posterior border slightly excavated; area small, transversely striated, the striations being large and irregular; marginal and inner carinæ narrow, elevated and striated; the tuberculated costæ are numerous (18 in the adult), curved concentrically with very densely arranged tubercles; the tubercles are rather depressed, ovate or clavate, their longer diameter directed downwards.

A pretty little species distinguished from the young of *T. striata* by the more numerous costæ and by the peculiarities of the tubercles.

It is rare; for the present example I am indebted to the kindness of the Rev. P. B. Brodie, who has procured several specimens in the shelly freestone of Leckhampton Hill.

Trigonia clavo-costata, Lycett. Pl. XI. fig. 6.

Trigonia clavo-costata, Lycett in Ann. & Mag. Nat. Hist. 1850, p. 425.

Shell subtrigonal; umbones obtuse, not recurved, anterior side produced, its border rounded, posterior border straight, oblique and truncated; area flattened, finely striated transversely and tricarinated; the marginal and median carinæ have regular moderate-sized tubercles, the inner carina has numerous transverse plications; the other portion of the surface is ornamented with a few rows of concentric tubercles; the tubercles are large, about eight in a row, the first two or three, and the latter one or two rows consisting of costæ which are not divided into tubercles.

Compared with *Trigonia decorata*, it is smaller and shorter posteriorly, the area has finer striations, the carinæ have larger and more distantly arranged tubercles, the concentric costæ have

much larger tubercles; they are about half as numerous as in *T. decorata*; lastly, the few primal costæ are smooth, in the other species they are tuberculated.

A specimen in the cabinet of the author, and a second in that of Dr. Wright, are the only examples with which I am acquainted; they are nearly of equal dimensions, and agree in all their characteristic features.

Length upon the marginal carina $1\frac{3}{4}$ inch, opposite measurement $1\frac{1}{2}$ inch.

The building-stone of the Inferior Oolite which forms the upper portion of its middle division is the seat of this species, which has been obtained in the vicinity of Nailsworth.

Trigonia costata.

Trigonia costata, Lam., Sow., Zeiten, Deshayes, &c.
Typical form *Costata*.

Anterior border truncated; umbones prominent, recurved; area slightly concave, with denticulated oblique plications, which differ in the two valves, the area of the right valve having two, three, or four large plications upon its anterior half, and no distinct median carina; the area of the left valve has a distinct median carina, and four or five plications upon each side of it; the inner and marginal carinæ are prominent and dentated, the latter separated from the longitudinal costæ by a depression; lanceolate space between the inner carinæ reticulated; longitudinal costæ slightly undulated, with a graceful double curvature resembling an elongated letter *f*.

Var. 2. *multicosta.*

This variety is much smaller than the typical shell; it is somewhat more depressed, its anterior border scarcely truncated, the area more finely reticulated, the costæ equal in number to the typical form, but more delicate and closely arranged; *multicosta* only attains about half the linear dimensions of the typical form; it has occurred only in the bed called Gryphite grit.

Var. 3. *pulla.* *T. pullus*, Sow.

This small variety occurs both in the Inferior and Great Oolite of the Cotteswolds; the larger specimens have a length upon the marginal carina not exceeding 20 lines, but few specimens are so large. The anterior border is not truncated, the carinæ and the intercarinal plications are prominent; in the Inferior Oolite it occurs in the freestone beds.

Var. 4. *sculpta.*

In dimensions this well-marked variety equals the typical form; in certain localities it occurs in the Gryphite grit in immense abundance; it is distinguished from the typical form by several conspicuous characters; the figure is less trigonal, the anterior border being destitute of any truncation; the umbones have less prominence and are less recurved, the area is larger, flatter, it is less concave, and occupies a much larger proportion of the surface of the shell; the marginal and inner carinæ are larger, less curved, and in common with the intercarinal plications, they are much more strongly dentated; owing to this prominence of the plications the median carina is much less conspicuous, the posterior half of the area is more depressed than the anterior, so that a distinct mesial division is formed irrespective of the median carina. In the young state the median carina is distinct in each valve, but in progress of growth that of the right valve degenerates into one of the common oblique plications. The costæ are large and elevated, but they have not the graceful double curvature of the typical form.

This variety therefore differs from the typical form in its proportions, its general outline, and in the greater prominence of its surface ornaments; but the peculiarity which distinguishes the species in the character of its area is present in all the varieties, and serves to separate them from all of the allied costated forms.

Trigonia costata is stated to occur over the whole of Europe, and there is even a presumed variety of it from Cutch, figured and described by Mr. James Sowerby in the 'Geol. Trans.' vol. v. 2nd Ser.; it is, however, not improbable that a further acquaintance with the varieties of this shell and of allied costated species may lead eventually to altered views, both of their stratigraphical and geographical distribution.

The costated *Trigoniæ* from the lower Oolite of Switzerland, figured by Agassiz under the names of *T. lineolata* and *T. denticulata*, would appear from his figures and descriptions to be distinct from *T. costata*; the accuracy of the figures in the 'Petrefacta' of Goldfuss is exemplified in the fidelity with which the artist has delineated the area of the right valve in the young specimen, although its peculiarities are not alluded to in the description; the typical figure of Agassiz is correct, but it may as confidently be asserted, that the figure of the *right area* in the same plate has incautiously been transferred from the *left valve*, or it would have exhibited the peculiarities upon which I have insisted as marking the species.

Trigonia angulata, Sow.

Trigonia angulata, Sow. Min. Con. tab. 508. fig. 1.
Trigonia clavellata, Sow. Min. Con. tab. 87, *the two lower figures*.

Shell elongated and rostrated, posterior border concave, anterior border rounded; umbones recurved; area narrow, bounded by small crenated carinæ; costæ narrow, closely arranged, straight anteriorly, undulated posteriorly, where they form large tuberculated varices, the few last varices directed downwards. M. D'Orbigny (Prodrome de Paléontologie) considers *Trigonia undulata*, Fromberg, to be only a synonym of *T. angulata*: in this opinion I do not concur; the figure of the two shells is essentially different, *T. angulata* being much more elongated, and the umbones more recurved; the surface ornaments of the shells likewise differ; those of *T. angulata* are remarkably constant and invariable.

T. undulata has not been recognized in the Oolites of England; on the other hand, *T. angulata* has not been discovered upon the continent. *T. angulata* has occurred at many localities in the Cotteswolds, both in the middle and upper portions of the Inferior Oolite, but it is rare. The imperfect specimen of *T. angulata* from Little Sodbury, which is given in the two lower figures of table 87 of the 'Mineral Conchology' as *T. clavellata*, has been the source of much confusion to subsequent observers, and has led them to catalogue clavellated specimens (usually imperfectly exposed) as *Trigonia clavellata*; but the figure in the same work of *T. angulata* is so characteristic, that it may be relied upon when the shell itself cannot be obtained for comparison.

Trigonia duplicata, Sow.

Trigonia duplicata, Sow. Min. Con. tab. 237. figs. 4, 5.

Shell slightly rostrated, area narrow, carinæ two in each valve, small, distinct; costæ narrow, serrated, the first few concentric, the others directed downwards, for the most part bifurcated and slightly waved. Should the *T. Proserpina* of D'Orbigny prove to be distinct from this species, it must possess peculiarities which are not alluded to in his 'Prodrome de Paléontologie,' where the brief description given agrees with *T. duplicata*. M. Agassiz (probably from an imperfect knowledge of the species) has placed *T. duplicata* with the *Scabræ*, but the very distinct marginal carina and the area destitute of transverse costæ clearly remove it from that section, which first appeared with the species of the lower greensand.

T. duplicata occurs in the upper division of the Inferior Oolite in the Cotteswolds, where the external impressions are not un-

common, but the shell itself is rare; it has also been found in the Great Oolite of Minchinhampton.

Trigonia Phillipsi var.

Trigonia Phillipsi, Mor. & Lyc. Gr. Ool. Monogr. 1853, tab. 6. fig. 1. p. 62.

Shell ovately trigonal; umbones submedian, obtuse, scarcely recurved, anterior border rounded, posterior border short, truncated; marginal and inner carinæ delicate, tuberculated and small; area narrow, flattened, striated, divided in its middle by an oblique furrow; sides of the valves with densely arranged, elevated, concentric, and finely indented or tuberculated costæ.

The present variety of the Lincolnshire shell, and of which I only know two examples, has the anterior portions of the costæ rather indistinct, and their junctions with the posterior and more curved portions form a kind of angle.

A more detailed description will be found in the monograph above referred to.

Trigonia signata, Ag.

Syn. *Trigonia clavellata*, Zeiten, Petref. Wurtemb. t. 58. fig. 3.
T. signata, Ag. Mém. sur les Trigonées, p. 48. pl. 3. fig. 8.

The most elongated and depressed of the *Clavellatæ*; the umbones are not prominent nor recurved; the area is lengthened, flattened, nearly smooth; carinæ nearly obsolete, rows of tuberculated costæ numerous, directed downwards, tubercles equal, scarcely separated, placed upon raised costæ.

Rare: position the lower or Ammonitiferous beds of the Inferior Oolite near Stroud.

Trigonia striata, Sow.

Trigonia striata, Sow. Min. Con. tab. 237. fig. 1–3; Agassiz, Mém. sur les Trigonées, pl. 4. fig. 10–12.

Shell somewhat depressed; umbones recurved; area flattened, bounded by two distinct narrow finely indented carinæ; costæ raised, numerous, concentric, deeply serrated, and varying in their number.

Trigonia Phillipsi, Mor. and Lyc. Gr. Ool. Mon. would easily be mistaken for this species, but the Lincolnshire shell is shorter, the umbones not recurved; the costæ are much less raised, more closely arranged, and so finely serrated as to appear smooth to the unaided vision.

Trigonia striata ranges throughout the Inferior O[illegible] Cotteswolds, and is abundant at P[illegible]

Trigonia subglobosa, Mor. & Lyc.

Trigonia subglobosa, Morris & Lycett, Gr. Ool. Monog. Bivalves, 1853, tab. 5. fig. 21. p. 55.

Shell nearly circular, convex; umbones recurved; area small, with three tuberculated carinæ; costæ large, closely arranged, angulated, their posterior portions forming a few large perpendicular varices.

It occurs in the freestone beds near Nailsworth; also in the Great Oolite: in both formations it is somewhat rare.

XXIV.—*Note on the Artesian Well at Colchester; and Remarks on some of the Microscopic Fossils* from the Colchester Chalk.* By John Brown, Esq., F.G.S., of Stanway.

[With two Plates.]

In 1852 an Artesian well was made at the western end of Colchester, Essex, on the premises of the Old Water Works. The surface of the ground at this spot is about 60 feet below the top of the adjoining hill, known as Balkern Hill. The red sandy gravel† composing the chief mass of Balkern Hill has a total thickness of about 60 feet, but at the well the gravel is about 6 feet thick only, with 6 feet thickness of alluvium covering it. The boring then traversed the "London clay," 100 feet thick, and the "Plastic clay" ("Reading and Woolwich Series" of Mr. Prestwich), which is 30 feet thick, and then penetrated the "Chalk with flints" to a depth of 152 feet—making altogether a depth of 294 feet.

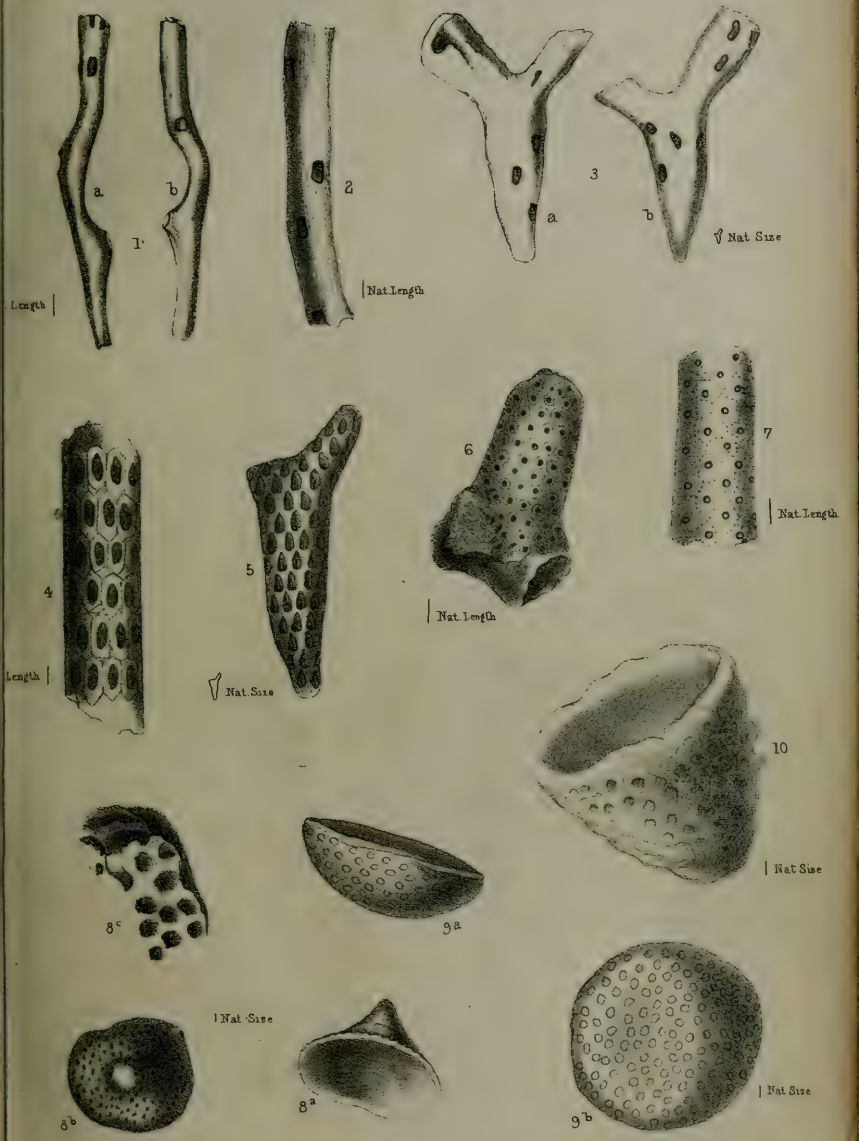
From the chalk brought up by the borer, numerous minute fossils have been obtained by carefully washing the fragmentary chalk and examining it under a lens. These consist of small Serpulæ, ossicles of Apiocrinites, and remains of Amorphozoa, Foraminiferæ, Bryozoa, and Entomostraca; such as are usually plentiful in and characteristic of the chalk.

Figures 8, 9, & 10 in Plate IX. are the calcified remains of three minute species of Sponges, of the genera *Tragos* and *Manon*; but they are too much water-worn and mineralized for identification.

Of the Foraminiferæ, *Nodosaria Zippei*, *N. limbata*, *Marginulina*

* Mr. Rupert Jones has kindly assisted me in drawing up the following notes on the microscopic fossils of the Chalk.

† Some remarks on the Gravels of this district, and on their lithological [illegible] by the author, may be found in the 'Mag. Nat. Hist.' 1835, [illegible] Quarterly Journal of the Geological Society,' 1852,



Zoophytes. Chalk, Colchester

W. Smith lith.

Printed by W. Monkhouse, York.

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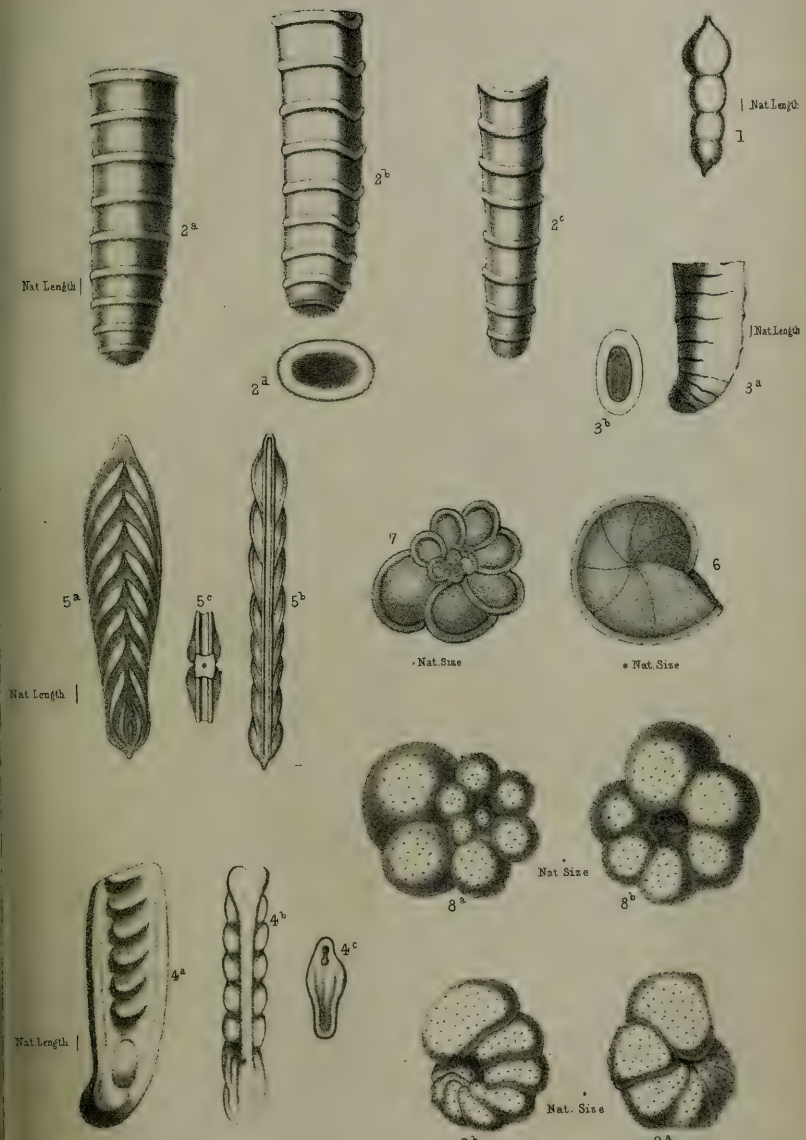

Foraminifera, Chalk, Colchester.

Printed by W. Monkhouse, York.

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ensis, M. elongata, M. trilobata, Frondicularia Verneuiliana, F. Archiaciana, Flabellina rugosa, F. cordata, Cristellaria rotulata, Rosalina ammonoides, R. marginata, Truncatulina Beaumontiana, Globigerina cretacea, and *Bulimina variabilis* are the most numerous. *Cristellaria rotulata* is especially conspicuous in the group, and is a species that abounds in the chalk* of every locality, both in England and on the continent. Some of these forms have been selected for illustration in Plate IX. The recent analogues of these fossil *Microzoa* are exceedingly plentiful in most seas and estuaries, their elegant little shells being easily obtained in the sands, mud, and seaweeds. The Foraminiferæ hold but a low place in the scale of animal life, and are not far removed from the Sponges. They are stomachless, and consist of a number of minute gelatinous bodies (in shape globular, disciform, wedgelike, &c.), arranged in a more or less regular, often symmetrical series (straight, curved, spiral, alternate, &c.), and coated with a thin calcareous shell, which is often perforated all over, and always exhibits one or more large holes, through which the gelatinous mass is protruded for the formation of a new bud-like body, and in some cases in the form of irregular tentacles (pseudopodia) for the purposes of attachment and locomotion. Certain species are characteristic of different oceanic areas in the present day; and the different geologic epochs have their own peculiar forms. Exceptions to this rule exist; some species have a world-wide existence, and some species of the genera *Globigerina, Dentalina, Globulina,* &c. have extended their range from the chalk and tertiary seas to the present.

Of the remains of Bryozoa,—which are minute animals, allied to Mollusca, inhabiting cellular cavities on small calcareous axes, which are generally cylindrical or flattened, and form branched or foliaceous bodies, either free or fixed to rocks, shells, seaweeds, &c.,—numerous fragmentary remains were obtained from the chalk of Colchester. Owing, however, to the fragments having been already much water-worn previously to their having been imbedded in the chalky mud of the ancient sea, but little definite indication of the original shape of the characteristic cell-cavities remains, the delicate cell-mouths and their tracery having been quite worn away. A few specimens illustrative of these forms are shown in Plate VIII.

The Entomostraca are small bivalved Crustaceans: the valves are generally of an oblong or oval shape, and are distinguished one from another chiefly by the character of the hingement.

* It is also abundant in the sands of the shore at Dover (from the disintegrated chalk of the cliffs), in the drift of Essex, &c., and the chalk detritus of Charing, Kent.

Cytherella ovalis, Bairdia subdeltoidea, Cythere punctatula, and *Cythereis ciliata* are those most usually met with both in the Colchester chalk and in the chalk of England and Europe generally.

EXPLANATION OF PLATES VIII., IX.

Plate VIII.

The natural size of the object accompanies each specimen.

Figs. 1, 2, & 3. *Dendropora*?
Fig. 4. *Ceriopora*; like *C. tubiporacea* of Goldfuss (Petrefact. Germ.).
Fig. 5. *Melicertes*?
Figs. 6 & 7. *Pustulopora*; like *P.* (*Ceriopora*) *madreporacea* of Goldfuss (Petrefact. Germ.).

Fig. 8. *Tragos*: *a* & *b*, the two opposite sides; *c*, highly magnified portion.
Fig. 9. *Manon*: *a* & *b*, two views.
Fig. 10. *Tragos*.

All of these specimens are much worn, and do not possess sufficiently well-preserved characters for exact identification.

Plate IX.

The natural size of the object accompanies each specimen.

Fig. 1. *Nodosaria limbata,* D'Orbigny *.
Fig. 2. *Marginulina ensis,* Reuss (fragment): *a, b, c, d,* different views.
Fig. 3. —— *elongata,* D'Orb. (fragment): *a,* side view; *b,* the broken end.
Fig. 4. —— *trilobata,* D'Orb.: *a,* side view; *b,* back view; *c,* view of the outside of the last chamber, showing the aperture.
Fig. 5. *Frondicularia Verneuiliana,* D'Orb.: *a, b, c,* different aspects.
Fig. 6. *Cristellaria rotulata,* Lamarck sp.

This species was termed *Lenticulites rotulata* by Lamarck; it is the *Nummularia Comptoni* of Sowerby. M. D'Orbigny recognized it as a *Cristellaria.*

Fig. 7. *Rosalina marginata,* Reuss; upper side.
Fig. 8. *Globigerina cretacea,* D'Orb.: *a,* upper side; *b,* under side, the last two cells each showing an aperture. The dottings on this and on fig. 9 indicate the coarseness of the minute perforations.
Fig. 9. *Truncatulina Beaumontiana,* D'Orb.: *a,* upper side; *b,* under side.

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* For minute descriptions of these and other Cretaceous Foraminiferæ, consult a memoir by M. A. D'Orbigny in the 4th volume of the 'Memoirs of the Geological Society of France'; and Dr. Reuss's work on the 'Fossils of the Bohemian Chalk.'

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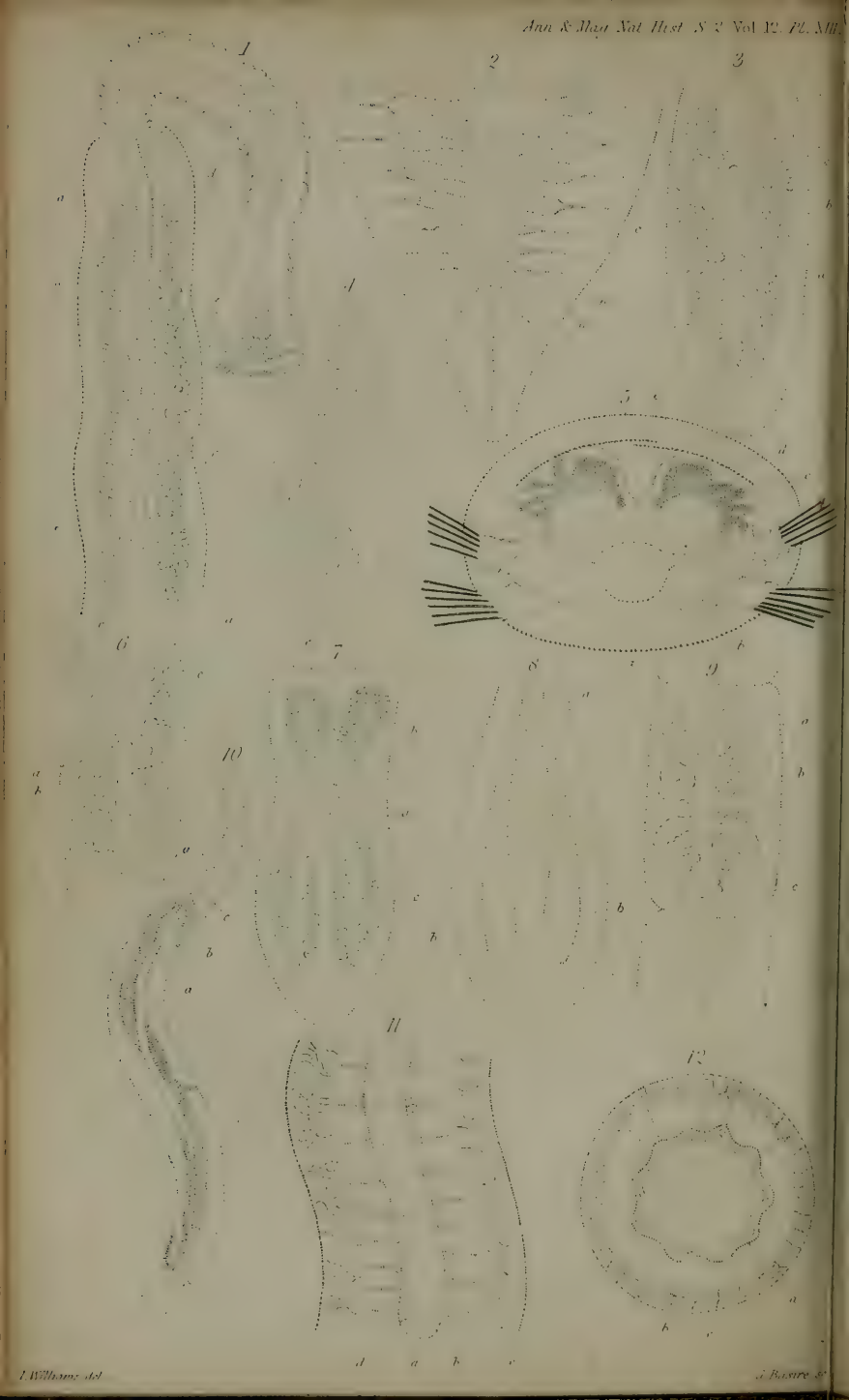
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XXV.—*On the Mechanism of Aquatic Respiration and on the Structure of the Organs of Breathing in Invertebrate Animals.* By Thomas Williams, M.D. Lond., Licentiate of the Royal College of Physicians, formerly Demonstrator on Structural Anatomy at Guy's Hospital, and now of Swansea.

[With a Plate.]

The mechanism of breathing in the countless hosts of invertebrate animals which people the ocean, offers a problem which has never yet been satisfactorily solved. The mode in which life is sustained in those degraded forms, in which "a circulation of blood" is not to be discovered, has long stimulated the curious wonder of the naturalist. Fishes and Cetacea excepted, the invertebrate animals constitute the entire population of the ocean. Insects excepted, all invertebrate animals are aquatic. Hence the wide range of interest which belongs to this subject. How animals breathe is not second in importance to the question how they live. Every observer studies the latter, few the former. There are "habits" associated with the manner in which the function of breathing is performed which are well-fitted to win admiration. Wanting the knowledge of this process, not the smaller half of the history of an animal remains to be acquired.

It is the aim of this memoir to demonstrate first the anatomical conditions under which the office of respiration is performed in the invertebrate animals, and then to study the process itself. The anatomical conditions will prove as various as the classes of which this subkingdom is composed. Two primary divisions of this subject demand at once to be recognised;—1st, that comprising those organs which adapt the animal for atmospheric breathing; 2nd, that qualifying it to respire in water. The latter, embracing varieties more striking and numerous than the former division, should again be resolved into two denominations, of which one would comprehend the mechanism of those organs by which the *chylaqueous fluid* is submitted to the agency of the aërating element, and the other, that of those fitted to expose the true blood*.

All vertebrated animals, fishes excepted, breathe on the atmospheric plan. All invertebrate animals, insects excepted, respire on the aquatic model. The organs used in the first method are more complex than those comprised in the second; while the chylaqueous fluid is subjected to respiration, through the *least* complexly arranged mechanisms. The simpler the fluid to be

* The author would here beg to refer the reader, for a full statement of the grounds of this latter subdivision, to his paper on the Blood-proper and Chylaqueous Fluid, &c., in the Phil. Trans., Nov. 1852.

aërated, the less involved is the disposition of the solid parts through which the exposure is effected. Elaborately vitalized blood is circulated through respiratory organs of inconceivable complexity and subdivision. The study of the mechanical conditions of respiration should regard the *fluids* as well as the *solids* of the structures dedicated to this function. The floating cells of the fluids are concerned in, though not essential to the respiratory process. The *true capillary segments* of the lungs of *all* vertebrated animals, those of reptiles *not* excepted, are destitute of vibratile cilia. The branchiæ of fishes, without a single known exception, are clad only by a *non*-vibratile epithelium. The general proposition, that ciliary epithelium constitutes no part of the *active portions* of the breathing organs of vertebrated animals, rests therefore upon the stable basis of actual demonstration. This negative must be changed into an affirmative statement, with reference to the air-*passages*, which in the pulmonary vertebrated series are profusely and universally ciliated. The presence of cilia on the branchial structures of invertebrated animals is a common, but not a constant fact; the rule without intelligible reason is suspended in numerous instances. The operation of cilia is therefore *not* indispensable to the respiratory process, even in the invertebrate animal—not an *essential* constituent even of the aquatic model. The blood of all vertebrated animals is richly charged with corpuscular elements. It is invariably coloured red. In the invertebrated subkingdom not one example is known of a corpusculated *red*-blood. The blood of every known mollusc bears floating solid elements. In every articulated animal the true-blood abounds in organized corpuscles. In every annelid, without a single known exception, the blood-proper is perfectly destitute of morphotic elements; it contains no trace of visible cells. The perfect fluidity of the true-blood of all Entozoa can also now be affirmed. Every Echinoderm is endowed with an imperfect blood-system, the blood-proper bearing cells in suspension. The chylaqueous fluid of every animal in which it exists, is charged more or less abundantly with organized corpuscles. The generalization is thus incontrovertibly established, that there exists no single instance of a real animal, of which one or other of the circulating nutritive fluids of the organism, is not replete with morphous particles. What office, if any, these floating solids exercise in the *mechanism* of the respiratory act, it is the province of the physiologist to determine; their microscopic characters it is the duty of the anatomist to describe.

Porifera.—In the Spongiadæ, the fluids to be aërated are contained *in* and *between* the component cells of the gelatinous cortex. Each separate cell, like that of *Amœba*, is an inde-

pendent organism. The included fluid, moved by the slow contraction of the cell-membrane, is a granulated, nutritive compound. That diffused between the cells, in composition, is less removed from the standard of sea-water. The latter replenishes the former. The inorganic fluid, entering from without into the interior of the living-cell-tissue, carries with it in solution a large amount of atmospheric air. In these lowly organisms, this dissolved air probably suffices to *oxygenize* their simple fluids. As the contained fluids are rapidly renewed, the nutritive and the respiratory process come to be performed by one and the same act. This is the history of the breathing function in the *Rhizopoda* and in *Actinophrys Sol*, recently described by Kölliker*. The superficies of the whole gelatinous cortex of the sponge is overspread by a film of ciliated epithelium. It has now been proved by Dr. Dobie† and Mr. Bowerbank, that the "currents" of the sponge are due to the agency of these motive organules. These currents are simultaneously nutritive and respiratory.

Polypifera.—Three varieties of plan, in the mechanical conditions of respiration, prevail among Zoophytes: the *Hydraform* (Pl. XII. fig. 2), the *Actiniform* (fig. 3), and the *Asteroid polypes* (fig. 1) exemplify three minor forms of one type of structure. In the first the space between the stomach and the outer limit of the body (fig. 2, *a*) is subdivided by the intersection of delicate tissue into areolæ, in which the fluid to be aërated is contained‡.

The fluid penetrates along an axial channel to the furthest

* See Quarterly Journal of Microscopic Science, Oct. 1852.

† See Annals of Anatomy and Physiology, No. 2, May 1852.

‡ The author has stated in the text the impression which he has derived from numerous observations on the common hydra of our pools, that the tentacles open into the *perigastric* areolæ, as shown at (*a*) fig. 2, and not into the stomach, and that they are *tubular*, not solid threads, as shown at (*b*) fig. 1. If, as recently stated by Prof. Allman (Proceedings of the Royal Society, May 31st, 1853), they open directly into the stomach, the tentacles can only be injected by the contents of the latter, and their function would partake of a digestive as well as a respiratory character; and further, the digestive system of the hydra would conform with the medusan type which is marked by the direct extension of canals from the stomach, and by the absence of a splanchnic cavity, the stomach being merely an excavation in the solid parenchyma of the body. The observations of Prof. Allman were instituted on *Cordylophora*, a genus of *Tubulariadæ*. According to my researches very lately made on *Tubularia indivisa* and *Alcyonium*, the tentacles are tubular and open into the perigastric chambers, which they equal in number. From its interest, this question cannot remain long unanswered. If in the hydraform and tubularian zoophytes the tentacles are prolongations of the stomach, properly so called, zoophytes, as a class, might be ranged under two leading divisions; that 1st in which the tentacles are *gastric*, and 2nd that in which they are *perigastric* prolongations. The *fluids* would admit of a similar division.

ends of the tentacles: they are *not* perforated at their distal extremities. In *Hydra viridis* and *H. fusca*, by means of the rolling granules, the fluid may be readily detected by the eye. It cannot be renewed *directly* from without. It is replenished *through* the walls of the stomach (*b*). The respiratory is here a function distinct and separate from the digestive. A living corpusculated fluid is submitted to the influence of the surrounding medium, by aid of the tentacles. These appendages in the hydraform zoophytes are furnished neither within nor without with motive cilia. They maintain the flux and reflux motion of the embraced fluid, in virtue of the contractile endowments of their parietes. In the *second* variety, illustrated by the sea-anemone (fig. 3, *b*), the open interval between the stomach and the integuments, though partitioned by dissepiments, is very capacious. The hollow axes (*c*) of the tentacles are continuations, in all species, of the perigastric space. They are filled with the same fluid as the latter. In some species of *Actiniæ*, the tentacles are perforated at the extreme ends: *Anthea Cereus* is an example. In the greater number they are cæcal. The *interior* of the tentacles, in common with the perigastric chambers, in *all* species are richly ciliated (*d*). The exterior of these appendages in many instances is covered only by an ordinary non-vibratile epidermis. The chylaqueous fluid* is an inferiorly vitalized

* Under this term (see Phil. Trans. 1852), the author has ventured to distinguish the fluid which occupies the gastric and perigastric cavities of *all* animals below the Annelida. He has elsewhere endeavoured to prove the proposition, that in all animals *below* the Echinoderms, it constitutes the *exclusive* nutritive fluid of the organism; that in those families, as in Zoophytes and inferior Echinoderms, in which it is readily ejected from the body and as readily replaced, it is very little removed in composition from salt water, and corpusculated only in a slight degree. It is simply albuminized sea water. But it has already undergone such preparation as fits it to enter the "protean" cells of the solids. Here, as illustrated in the examples of the *Amœba* and Sponge, it assumes a more highly vitalized and corpusculated character. It may be said that in the cells it is true blood, in the visceral cavity chylaqueous fluid. The difficult problem of respiration in the lowest forms of animal life can be solved *only* by determining the real stages through which the fluids pass in the processes of animalization. If the great mass of the chylaqueous fluid contained in the polypedal and visceral chambers consist of pure, unvitalized, unalbuminized sea water, *then* the tentacles can subserve no respiratory purpose; since between two fluids (that within, and the element without the tentacles), of identical composition and specific gravity, there can occur no interchange of gases. But if, on the contrary, to this great reservoir of fluid be assigned the value of a chylaqueous compound, though it may have undergone only the first and lowest grade of assimilation, *then* the entire mechanism of respiration and nutrition becomes intelligible. This argument enforces the physiological principle, which, in order to demonstrate the true seat of the aërating process, demands that the real constitution of the fluids be *first* discovered. In studying the nutritive and respiratory actions in *all* invertebrate animals,

albuminous compound. It possesses higher organic properties in those orders in which the tentacles are closed, than in those in which they are open. In the former it sojourns longer in the visceral cavity under the influence of the Zoochemical forces. It is in the interior of the cells of the solid structures that the chylaqueous fluid acquires its final properties. It suffers here a second and higher nutritive and respiratory change, or derives from the chylaqueous mass, still in the visceral cavity, a further supply of oxygen. The chylaqueous fluid is aërated in two modes; 1st, every portion of the element from without, which is admitted into the splanchnic cavity, brings with it a fresh supply of highly oxygenized air; and 2nd, it exchanges its carbonic acid for the oxygen of the surrounding element, in accordance with the principles of ordinary aquatic breathing. It is therefore a reservoir of richly oxygenated fluid, fitted well to impart a renewed proportion of oxygen to the more highly vitalized contents of the cells. It is evident that it is only by a clear statement of these *apparently* irrelevant particulars, that the anatomist can arm the physiologist with an adequate conception of the *physical conditions*, under which the respiratory function occurs in these degraded organisms. In all actiniform polypes, the bottom of the stomach communicates, by means of a sphincteric aperture, with the perigastric chambers. It is by this route that the large mass of the contents of these latter cavities are derived from without. The contained fluid receives the first impress of the vital chemistry, in its passage over the gastric surfaces. It is then prepared to undergo the respiratory changes in the visceral cavities. The preceding observations apply to the *third* (fig. 1) variety of plan (exemplified in the *Asteroid* families), on which in zoophytes the fluids are elaborated. There is little difference of structure between the asteroid and helianthoid polypes. In the former the stomach is prolonged into the axis of the polypidom (*c*). The perigastric chambers (*d*) also communicate, but in a less direct

one fact of singular interest should be remembered, the truth of which the author has established by numerous observations. The *cells* of the solid tissues are *contractile*; they *contract* and *dilate*: in the Cephalopods, the pigmented cells of the integumentary structures exhibit this property with remarkable distinctness. The pigment is deposited in the substance of the cell-wall. When the cell *contracts* the coloured point disappears, when it expands it assumes a conspicuous area. This is the simple explanation of the singular power, with which the Cephalopods are gifted, of *changing their colour*. It applies also to the chameleon. But in invertebrate animals it is not confined to the pigmented cells. It is exhibited by the non-pigmented cells of nearly all the structures of the body. The author has ventured in this place to bring it under the attention of the physiologist, because it is unquestionably a property of great importance in the circulation and aëration of the fluids.

manner than the stomach, with the channel of the stem. In these families, the tentacles, which are evidently the continuations of the perigastric chambers (fig. 1, *a*), are said to be perforate at their distal extremities: this point requires to be confirmed. The fluid filling the axial channel of the stem enters at the mouth of each polype, and descends through the orifice situated at the base of the stomach (fig. 1, *c*) into the polypidom. In this situation, in a great variety of species, the motion of the corpuscles contained in the fluid may be readily observed. They present all the characters of being driven by *cilia*. The presence of cilia is however controverted by some observers. From the polypidom the fluid passes upwards into the perigastric chambers, and thence into the tentacles in which it undergoes aëration. It is curious that the *corpuscles* of the fluid of the stem do *not* pass upwards into the tentacles. They are filtered back by the cribriform partition, which divides the chambers around the stomach from the axis of the polypidom. *New* observations are required on the whole family of the asteroid polypes, having special reference, 1st, to the arrangement and existence of cilia, and 2nd, to the distribution of the fluids.

The fluid by which the whole extent of the stem and visceral chambers of each individual polype are distended, constitutes one system. So rapidly is this fluid endowed with a low order of vital properties, enabling it to fulfil its functions as an element of nutrition, that it may be rejected *en masse*, to be replaced with a fresh volume of *in*organic water. Such is the converting power of the vital chemistry in these simple organisms. This fact distinguishes the polype families from all other invertebrate animals. The true character of the breathing function must have remained beyond the reach of the physiologist, without the knowledge of these points. They prove that the *lower* the vital endowments of the fluids, the simpler the mechanical arrangements required to effect their aëration. In zoophytes the nutritive fluid is not exclusively vitalized through the agency of floating cells, it is vivified in part, catalytically by *contact* with the surfaces of the living solids. The morphotic elements, therefore, which exist in the fluids of this group, are scanty in number, subordinate in function, and indeterminately organized. To detect the globules in the fluid of the polypary is easy. It is more difficult to trace its progress upwards into the space which surrounds the stomach, and thence into the tentacles. If, as lately stated by Prof. Allman*, the axes of the tentacles in the tubularian polypes open directly *into the stomach*, and *not* into the space to the outside of this organ, these appendages cannot be intended to expose the

* Proceedings of the Royal Society, May 31, 1853.

chylaqueous fluid to the aërating medium. Arising out of the roof of the stomach, as already stated, at the side of the oral orifice, they can be injected only with the contents of the stomach, and that periodically by muscular force. Such a mechanism, for organs which are indubitably respiratory, is in the highest degree improbable. The tentacles of the distended polype are filled undoubtedly by a *fluid*. In *this* fluid no corpuscles have yet been detected. Those observed so readily in the stem cannot be traced upwards beyond the base of the stomach: Prof. Allman denies even in the latter situation the existence of cilia. The globules move, according to this observer, as "the effect of the active processes, going on in the secreting cells of the endoderm, —processes which can scarcely be imagined to take place without causing *local* alterations in the chemical constitution of the surrounding fluid and consequent disturbance of its stability." However these questions may eventually be determined, it is certain that there exists in all zoophytes but *one fluid system*.

This fluid is compounded of the surrounding medium, whether it be sea water or fresh, and the organic products of digestion. By this quasi-inorganic fluid the nutritive functions of the organism are performed. In the tentacles it undergoes aëration; in the actiniform orders it may be collected in large quantities: it contains corpuscles characteristic of species*. It affords distinct evidence of the presence of albumen; it is destitute of fibrine; it is the lowest example under which a living nutritive fluid occurs in the animal kingdom, and yet *the cells of the solids* of zoophytes are eminently irritable and contractile. An inverse proportion obtains generally in this respect in invertebrate animals. The simpler the fluids, the more irritable and contractile the solids, the cells of the latter being larger than the corresponding parts of vertebrated animals.

Bryozoa (fig. 4).—The marine and freshwater polyzoa are molluscan in the character of their alimentary system, zoophytic in that of the fluids. Their position in the scale must be allotted according to the relative importance of these two systems: judged by the fluids, they claim to rank at the summit of the zoophytic series; by the alimentary organs, they would constitute the first link in the molluscan chain. The real signification of the fluids in the Polyzoa has never been understood. A perigastric cavity (*a*, *b*) is clearly described; the *fluid* within this cavity and its floating corpuscles have been repeatedly observed, but the physiological value of these parts has never been explained†. In these

* See the author's papers on the Blood, which are now in course of publication in the British and Foreign Med. Ch. Rev.

† In justification of the statements made in the text, the author would refer to the admirable report, on the Polyzoa, by Prof. Allman, in the Trans.

animals there exists neither a heart nor a blood-proper system. The fluids constitute an unmixed example of the chylaqueous system. They oscillate under muscular agency in the great visceral cavity (*a*,*b*); under the same force the fluid penetrates the tentacles which it traverses by a flux and reflux motion. These organs are plain, tubular appendages; they are continuations of the visceral cavity; —characters which are emphatically zoophytic. The tentacles of the Polyzoa differ from those of asteroid polypes in the presence of vibratile cilia. They are limited to the external surface, and arranged in a single row on either side: the interior of these branchial tubuli is not ciliated. Thus then is defined the whole apparatus of the chylaqueous system in this family. Henceforth the Polyzoa cannot be severed from the zoophytes.

Acalephæ (figs. 5, 6, 7).—The apparatus for breathing is, in this class, of simple construction: it consists of a system of cæcal canals in direct connection with the stomach. Four types occur —the Pulmograde, the Ciliograde, the Cirrhigrade, and the Physograde. In the first examples (*Aurelia, Pelagia, Chrysaora, Rhizostoma, Cassiopea* and *Cyanæa*), the stomach is a central lobulated chamber, furnished with one external orifice, the mouth, and opening laterally into canals which reticulate at the margin of the disc: they end cæcally. In *Cyanæa aurita*, they are prolonged *into* the fringed appendages which depend from the cir-

of the Brit. Assoc., 1850, in which the following statements occur. "The perigastric space and interior of the tentacula and locophore all freely communicate with one another, and are filled with a clear fluid, in which float numerous irregular particles of very irregular form and size.....That the fluid thus contained in the perigastric space, and thence admitted into the tentacles, consists really of water which had obtained entrance from without, there can, I think, be little doubt; and yet I have in vain sought for any opening through which the external fluid can obtain admittance into the interior.....The fluid which circulates in the perigastric space is not perfectly homogeneous, and numerous corpuscles of various and irregular shape may be observed to float through it and be carried about by its current. Some of these corpuscles are perhaps spermatozoa; others are of no definite shape, and look like minute portions of the tissues separated by laceration. May they not be some of the products of digestion, which have transuded through the walls of the alimentary canal, being thus conveyed into the *only* representative of a true circulation, with which these animals present us?" From the preceding passages it is undeniable that this excellent naturalist has not clearly seized the significance of that which he has described so graphically. He admits that the fluid of the perigastric cavity is the *only* fluid system discoverable in the organism of the polyzoon. He disputes the organic character of the fluid, while he *hints* at its nutritive properties. It is in truth a true and perfect *chylaqueous system*, and as adequate as blood-proper to the wants of the living organism. In the Polyzoa, there is discoverable no trace of a blood-proper system. They therefore *fail* in one of the most essential characters of the molluscan organism—the existence of a heart and an associated circulatory system.

cumference of the disc. The system of the gastro-vascular canals (fig. 5, *c, d*; fig. 6, *c, d*; fig. 7, *c, d*) in the *Discophoræ*, forming a horizontal plane, rest in immediate contact with the *inferior* surface of the disc—that is, the whole substance of the disc intervenes between them and the *upper* surface: the under surface of the disc externally, in every species, is ciliated; the superior is not so. The stomach *and the canals* (*c, d*) to their remotest terminations are ciliated *internally*. This fact distinguishes these canals fundamentally from blood vessels; they are filled with a fluid which is imperfectly vitalized, a chylaqueous compound; it is replete with floating organized corpuscles. The flux and reflux motions of this fluid are excited, partly by cilia, and partly by the rhythmic contractions of the disc. Respiration is accomplished in two modes; partly by the interchange of gases on the under surface between the contents of the canals and the surrounding element, and partly by the air suspended in the external fluid, which is admitted through the mouth and stomach into the gastro-vascular channels directly from without.

The basis and bulk of this fluid is composed of salt water, but qualified by the impresses of the zoochemical influence to sustain the *life* of albumen, fibrine, and to evolve definitively organized floating corpuscles. The refuse portions of this fluid are rejected *per os*; there is no anal outlet. The cells of the solid structures of the Acaleph are filled with a semifluid hyaline jelly; it is the chylaqueous fluid in its highest grade of organization. In the Medusa, it is to the chylaqueous fluid, what the contents of the "protean" cells of the gelatinous cortex are to the currents of the circumambient element, traversing the passages in the sponge: thus, in brief, is conveyed a description of the *machinery* of the respiratory process in the Acaleph; from it the nutritive processes cannot be distinguished. The *Ciliograde* family departs from the type of the former in one particular; there exists here a *second* orifice to the digestive system (fig. 7, *b*). The fact alters not the principle of the mechanism, according to which the fluids are aërated. The gastro-vascular canals arise from the fundus of the stomach, attain the surface, and pass in meridional series (fig. 7, *c, d*) from one pole of the body to the opposite, lying immediately underneath the external epidermis. Their courses are followed externally by rows of motive cilia, or vibratory fringes: all the canals peripherally terminate cæcally; they are furnished on *their internal* surfaces with cilia. The genera *Cydippe, Cestrum* and *Callianira* are illustrative.

In the *Cirrhigrade Acalephs*, the second orifice of the alimentary apparatus disappears. The canals, filled with the chylaqueous fluid, radiate, while they multiply in the direction of the cir-

cumference of the disc. Like those of the preceding families, they are ciliated internally, while they are distributed in close proximity to the under surface of the dome.

The organization of the *Physograde Medusæ* is little understood*.

It cannot be doubted, that in the *fluids* of the Acalephs, floating corpuscles, from their multitude and their determinate structure, exercise an important part. They animalize the fluid; they endow it with life. Directly or indirectly they develope the proximate principles out of the inorganic elements. Both the corpuscles and the fluid contained in the gastro-vascular canals are nearly colourless. Here, as in many other instances amongst the invertebrate animals, the lesson is taught, that *colour* has little to do with the capability of vital fluids to absorb oxygen. In this class, it is beyond question, that sea water is admitted directly into those canals in which the chylaqueous fluid is contained. The former is so rapidly assimilated with the latter, that the nutritive and vital character of the compound fluid resulting from the admixture is readily maintained at the required standard.

It is important to remark, that in all Acalephs the gastro-vascular canals are distributed as closely as possible to some *external* surface; in *Rhizostoma* to the under surface of the dome, in *Beroë* in meridional lines over the globe, in other species along the margins, &c. Such disposition has reference to the respiratory process: vibratile cilia in general are developed on those portions of the external surface which coincide with the gastro-vascular canals.

Echinodermata.—In this class the same questions arise, as important preliminaries to the study of the respiratory process, with those as to the *meaning of the fluids*, which were discussed with reference to the inferior Radiata;—which of the *three* orders of fluids, present in the œconomy of nearly every Echinoderm, is made the *special* subject of this process? 1st, the cavity of the body (figs. 8, 9, *d*; fig. 10, *n*) (*i. e.* the spacious interval which separates the digestive from the integumentary system) is filled in *all* species with a fluid which the author has called the *chylaqueous*: 2nd, the protrusile suctorial feet (Pl. XII. fig. 8, *g*; fig. 9, *f*) are occupied by another class of fluid; this system constitutes the water-vascular system of Tiedemann and Müller; 3rd, the blood-vascular system (fig. 10, *j*), of Tiedemann, Delle Chiaje, Valentin, Agassiz, Dr. Sharpey and Müller: these three systems are defined as severally distinct and independent, and

* See a paper in the Ann. des Sc. Nat. tom. xviii. "Sur la Structure des Physalies et des Siphonophores," by Leuckart.

their functions respectively are alleged to be distinct and independent. In what conceivable manner is the descriptive anatomist to depict the breathing systems of these animals, unless by that of first adjusting these long-controverted questions? The ultimate structure of those solid parts, on which the office of aërating the vital fluids is represented to devolve, must be first determined. This inquiry alone can prove to what extent, if at all, these parts are capable of answering the purpose which they are stated to fulfil. The chylaqueous system of fluids exists in *every* Echinoderm; the water-vascular system does *not* exist in every species. In the *Sipuncles* and the *Ophiuridæ*, it has no place. The blood-vascular system is very imperfectly known. Little has been done to demonstrate its presence in the asteroid Echinoderms, and still less in the Echinidæ. Its history has been most fully developed in the Holothuridan and Sipunculidan genera.

1. *The Chylaqueous System of the Echinoderms.*

Is it capable of subserving a respiratory purpose? Is it constituted such that it is physiologically capable of executing this great function? And is it also *distributed* appropriately?

The mass of fluid occupying the visceral cavity, bounded on one side by the digestive system, on the other by the integuments, has been described, by the classical authorities upon this subject, as consisting purely of sea water, admitted *directly* from without through the skin, for the exclusive purpose of aërating the blood-proper, said to circulate in a *capillary* system of vessels wrought in the solid parietes circumscribing the cavity. This, in succinct expression, is the doctrine of the schools, as to the mechanism of respiration in this interesting class of animals. It supposes the existence of a profuse plexus of capillary vessels carrying true-blood, distributed over *all* the visceral and parietal surfaces limiting the chamber in question. It may be at once stated, that no approach to a demonstration of the presence of this system has ever been made by *any* modern or ancient anatomist. Is it logical to erect one hypothesis upon another? Let *facts* be first represented. In the Asteridæ, Echinidæ, Ophiuridæ and Ophiocomidæ, the fluid contained in the peritoneal cavity has been described by every comparative anatomist as pure unmixed sea water. It cannot be denied that the cavity itself is the anatomical homologue of the real perigastric chamber of zoophytes and of the gastro-vascular canals of Medusæ. It is therefore the anatomical *locale*, in which the chylaqueous fluid *should* accumulate; but under what character does it occur in the higher vermiform Echinoderms? In the Holothuridan and Sipunculidan genera (fig. 10, *n*), it presents itself as a chamber

filled with a chylaqueous compound, under the unquestionable form of a thickly corpusculated milky fluid, organized in a high degree, and oscillating as a living nutritive fluid: it is by tracking the characters of this fluid from above downwards, that its real signification in the inferior Echinoderms, in which it offers the *apparent* properties of simple sea water, can be unerringly ascertained. The floating corpuscles of the chylaqueous fluid of the Sipuncles (fig. 10, *h*) present the features of *constancy* in structure and proportion; they are always the same in the same species. The cephalic appendages in this genus, as well as the whole integumentary system of the body, are organized with express reference to the exposure of *this fluid*, and this fluid exclusively, to the agency of the external aërating element.

The skin is *fenestrated* (fig. 11, *d, d, d*), that is at regular intervals the muscular layer disappears, and an interval of elliptical figure, covered over only by a single layer of epidermis, results. In the *solid* structures of the integuments there is no trace whatever of a capillary vascular system to be detected. It is a simple membrano-muscular partition, intervening between the chylaqueous fluid within and the surrounding element without: it is *through* this veil that these two divided fluids interchange their dissolved gases. The tentacles present the same precise mechanism (Pl. XII. fig. 10, *a* & *C*, & *B*); they are merely hollow appendages, musculo-membranous, lined *within* and *without* by a ciliated epithelium. A *few* proper blood vessels reach their bases from the circular vessel; but *no* trace whatever of a vascular plexus, in the *structure* of these parts, can by any manœuvre be discovered. The inference is irresistible, that, like the skin of every part of the body, which *internally* is universally ciliated, the tentacles are designed almost exclusively as instruments for the oxygenation of the chylaqueous fluid (*not* the blood proper), which oscillates by a flux and reflux movement in their hollow interior. To the genus *Holothuria* these observations in every detail are strictly applicable. The tentacles, however, though hollow membranous appendages, are furnished, *in the substance of their parietes*, with a few more blood-vessels: the skin is fenestrated like that of the Sipuncles (fig. 11); the open cavity of the body is occupied by a highly organized corpusculated fluid which the solid parts just described are expressly fitted to aërate. From its volume, its organic composition and its suspended cells, its importance in the organism cannot be disputed. It cannot acquire nutritive properties unless through the agency of oxygen. This element can be received through no other provisions than those exhibited by the skin and the tentacles: thus the *theory* of respiration, with respect to the chylaqueous fluid, in these superior Echinoderms is complete. Although attenuated at

regular points, with a view to approximate as closely as possible the chylaqueous fluid to the external medium, no *open perforation anywhere* exists in the tentacular or integumentary processes. The surrounding fluid cannot therefore penetrate *directly* from without into the peritoneal cavity*. It is introduced through the mouth and the digestive system.

In the *Ophiuridæ* and *Ophiocomidæ*, the visceral cavity is filled with a fluid, which, though not so highly organized as that of the preceding genera, is undoubtedly the same system: it is not so milky in appearance; it approaches more to that of pure salt-water. Its floating corpuscles are far less abundant, and more indefinitely formed; its oscillations are ceaseless under the movements of the arms and action of cilia. At the flexures of the articulated pieces of the arms, soft, membranous, hollow processes, opening into the peritoneal cavity, protrude.

They are designed to aërate the fluid contents of the visceral chamber: unlike the membranous integumentary projections of the Asteridæ, they are neither ciliated within nor without. They may be seen perfectly in the smaller species, as transparent objects. If any vestige of a blood-proper system of vessels occupied the substance of their parietes, it could not, thus examined, escape detection; none such exists. Wherefore then are these specific organs provided, if not to arterialize the great system of fluid which penetrates into their interior? The answer cannot be withheld; it is to aërate the chylaqueous fluid exclusively†. The chylaqueous system of the Echinidæ (fig. 9), comprehending a considerable mass of fluid filling the cavity of the spherical shell (*d*), has never yet been recognised by the anatomist as a vital organic system. The great authorities, Agassiz especially, formerly quoted, state that sea water streams into the visceral cavity through perforations in the membranous processes (fig. 9, *f*, *f*) of the shell, especially in those under the name of *branchiæ*, which are distributed in groups around the circumference of the oral membranous disc. The latter are *not* connected with the suctorial or water-vascular system; they are distended by injections thrown into the open chamber of the shell.

They are protruded only by the force of the fluid driven into their interior. They collapse by contractility of their parietal

* The author would again refer the reader to his recent memoir in the Phil. Trans. (1852), for a full and complete statement of the anatomical and experimental evidence, by which are substantiated the general propositions enounced in the text.

† It will be afterwards shown, that comparative anatomy has done absolutely nothing towards the demonstration of the blood system of these Echinoderms. A circular vessel is stated by Müller only to surround the mouth.

structures. They are *not perforated* at their extremities (*b*). They *cannot* therefore serve as open passages for the direct admission of the external medium into the visceral cavity. They are unquestionably in part tactile appendages. In addition to the meridional rows of suctorial feet, the shell of *Echinus* is perforated by numerous hollow membranous processes (fig. 9, *f, f, f*), lined within and without by vibratile cilia, and *penetrated* exclusively by the fluid of the visceral cavity. Like the integumentary structures of the higher genera, they bear no evidence whatever of blood-vessels. These facts impel the physiologist to the adoption of one inference. They *can* only subserve a respiratory purpose on the supposition that the *subject* of that process is the chylaqueous fluid. *Then* the conclusion cannot be evaded, that, although in the *Echinidæ* the fluid contained in the visceral cavity may *look* like simple sea water, it must be something more; else *nothing* would be signified by the express provisions supplied, to subject it to the process of aëration. It is, in truth a dilute albuminous solution, charged with corpuscles indeterminately organized. It possesses a higher solvent power for oxygen than simple sea water. It is the reservoir out of which the elements of the true blood are drawn. Injection thrown into the hollow of the shell of *Echinus* distends beautifully, in relief, numerous membranous appendages belonging to the integumentary system. In *no instance whatever* can any *perforations* in the extremities of these processes be detected. There is therefore no direct evidence for the opinion commonly entertained by the best observers of the Echinoderms, which affirms that the external water enters immediately through openings in the *integuments* into the peritoneal cavity*.

The preceding questions admit of more easy and satisfactory solution in the Asteridæ than in the classes of Echinoderms already reviewed. *Asterias rubens* is a large animal; the fluid

* On the subject discussed in the text, Müller, in his recent elaborate essays on the Echinoderms, published in his 'Archiv,' offers the following remark, which I produce in the original:—"Die baumförmigen Kiemen der Seeigel, die äusseren Kiemen Valentin's sollen an den Enden ihrer Aeste nach Tiedemann offen sein, auch das Wasser in das Innere des Seeigels aufnehmen. Diese Ansicht gründet sich auf Injection mit Quecksilber unter gleichzeitiger Anwendung von gelindem Druck. Valentin fand diese Organe dagegen an den peripherischen Enden geschlossen, so dass sie also hohle Verlängerungen der Leibeshöhle nach aussen darstellen, und die Athemfunction auf ihrer äussern Oberfläche stattfindet. Auch ich habe bei wiederholter microskopischer Untersuchung dieser Theile von lebenden Seeigeln *keine* Oeffnungen an den abgerundeten Enden wahrgenommen." Müller, however, does not explain in what manner the "Athemfunction" of these appendages, which he argues to be cæcal, is possible. His conclusions as to the *imperforate* character of these parts I have repeatedly confirmed by variously devised methods of examination.

by which the visceral cavity (fig. 8, *h*) is filled is considerable in volume. The whole integumentary structures are more readily subjected to demonstration. Everything is favourable to a final conclusion of the controversy which has long divided anatomists as to the real signification of the fluid contained in the visceral cavity: it can be placed, in several modes, beyond doubt, that *no open perforations* exist *in any part* of the integumentary parietes of *Asterias*. The membranous processes (fig. 8, *f*, *f*) *openly* communicating with the visceral cavity are so remarkably elastic and protrusile, that, by means of coloured size forced carefully into the cavity, they distended to a great distance above the plane of the external surface. They are *cæcal* at their distal extremities.

This injection escapes externally only by rupture: this simple expedient proves the cæcal character of these parts; they are *not* consequently designed to admit sea water into the interior of the body. It is perfectly easy to repeat and confirm the first observation of Dr. Sharpey, that the corpuscles of the visceral fluid advance to the distal end of these processes, and then return under the impulse of ciliary agency*. Although an injection so thick as size will not escape through these membranous processes, a thinner fluid, such as coloured water, will slowly ooze through; it is not therefore improbable that an interchange of the fluids, which their attenuated parietes only divide, may *to some extent* occur through endosmose. This fact, however, cannot shake the stability of the conclusion, that anatomy does not furnish *any* grounds for the belief that the fluid contained in the peritoneal cavity is derived directly from *without*. The microscope renders it certain that the hollow membranous processes, filled by the fluid of the visceral cavity in *Asterias*, bear in the solid substance of their parietes no trace of true blood-vessels; they are lined within and without by vibratile epithelium, and composed only of interlacing elastic fibres. What conceivable office can such organs execute, if not that of exposing the chyl-aqueous fluid to the renovating influence of the surrounding medium? In *Asterias* this fluid approaches "simple sea water" closely in physical properties. It is, however, in reality a dilute albuminous, opalescent solution. It is charged scantily with

* Müller confirms the conclusions stated in the text—"Die respiratorischen Röhrchen auf dem Rücken der Asterien, welche mit der Bauchhöhle communiciren sollen zufolge der Injection von Tiedemann am Ende offen sein, und zum Wechsel des Wassers des Leibeshöhle dienen. Nach Ehrenberg dagegen sind die Röhrchen am Ende geschlossen, er sowohl als Sharpey sahen die Strömungen im Innern am Ende umkehren. An jungen lebenden Exemplaren des *Asteracanthion violaceus* sah ich dasselbe, und es gelang mir nicht eine Oeffnung wahrzunehmen."—Anatomische Studien über die Echinodermen. Müller's Archiv, 1850.

imperfectly formed corpuscles always the same in the same species.

In other species of Asteridæ the membranous appendages of the skin present other varieties in size and figure, none in character and structure.

In *Uraster papposa* the membranous intervals in the calcareous trellis are large and favourable for examination. They may be readily seen with the naked eye in the living animal to be capable of being bulged out under the pressure of the fluid in the visceral chamber.

The Cribellidæ present another modification of the soft part of the integument. The skin is smoother, the membranous intervals are smaller, and the membranes are less capable of protrusion outwards. In every other respect they are identical with the corresponding parts of the preceding genera. The proposition may now then be finally affirmed, that in the Echinodermata the chylaqueous fluid (*i. e.* the contents of the visceral cavity) is *itself first* aërated, and that by means of a machinery of soft parts expressly arranged with a view to this end; and that then *it aërates the blood-proper.*

2. *Water-vascular and Blood-vascular Systems of the Echinoderms.*

To what extent, in what manner, if at all, do these two fluid-systems, or either of them, participate in the mechanism of the respiratory process? In solving the curious problem presented by the Echinodermal organism, the highest interest attaches to this question. Let it be first seen whether the statements of Tiedemann, Sharpey and Müller, that these systems are perfectly independent of each other and of the chylaqueous system already described, are really founded on trustworthy demonstration. No anatomist up to the present time has done more towards elucidating the anatomy of the true blood-system of the Echinoderms than that of proving the existence of certain central trunks *only*. This system has never been traced to its peripheric distribution *in any species* (the Holothuridan *perhaps* excepted) by any comparative anatomist. An induction is unsafe which is grounded upon hypothesis. The theory of respiration can only be constructed out of the materials supplied by the patient labours of the anatomist. It does not appear that Dr. Sharpey ever could verify the description of Tiedemann with reference to the blood-system. The tenuity of their coats however, and pale colour of their contents, render it extremely difficult to trace completely the distribution of the vessels*. Müller concurs in the description of Tiedemann, stating that in *Asterias* a circular trunk surrounds the mouth and gives off branches to each ray—

* Art. Echinodermata, by Dr. Sharpey.

adding the confession, that "*die Injection vom Blutgefässring gelang nur bis zum Anfang dieser Gefässe.*" And this is all that the author of this memoir has ever been able to accomplish to *prove* the existence only of the central trunks. This is the sum of the existing knowledge with reference to the blood-proper system of the Asteridæ. Of that of the Echinidæ very little also is known. Müller describes a circular vessel embracing the œsophagus immediately underneath the lantern; from this a trunk proceeds coursing along the curves of the intestine, and ending in the *circulus analis*. This learned anatomist observes, "*Um eine klare Vorstellung vom Herzen zu bekommen, muss man es bei* Cidaris *untersuchen; es ist bei* Cidaris *ein weiter, ganz gerader Canal mit dicken weichen Wänden**." In *Cidaris* the heart is not a circular vessel, but a fusiform trunk lying parallel with the intestine. The *circumference* of the blood-system in the preceding genera has never yet been brought under demonstration. In science negative is inferior in value to positive proof; but at present it is only possible to declare that no care can succeed in discovering any evidence whatever of the presence of a blood-proper system in the solid structures of any part of the body of the Echinoderm. The parietes of the alimentary canal are *most certainly* not ramified by blood-vessels. The soft parts of the integumentary system are literally destitute of vascular tissue. The contents of the central trunks of the blood-system are identical in appearance with those of the visceral cavity, *and* with those of water-vascular or suctorial system; that is, when the morphous elements of these *three* fluids are placed in juxtaposition under the microscope, it is impossible to indicate between them any difference whatever in structure or shape. The fluids themselves are also identical in every physical appearance.

The *blood-vessels are internally and externally lined with cilia*, the water-vessels are so, and the visceral cavity is richly so. What can these extraordinary facts mean? Can they mean any thing, but that these three systems are reciprocally connected? A *suspicion* to this effect has been expressed by Milne-Edwards and M. Quatrefages; but the author claims the merit of having first produced demonstrative facts which impart to this suspicion a very probable character. The question admits of more confident answer in the higher genera. The blood-vessel of the *Sipuncle* may be readily exposed: it lies on the intestine in form a bright pink thread (fig. 10, *m, j*); it exists only on one side; it has no discoverable correlate on the opposed side of the cylinder; it is filled with pink fluid, the corpuscles of which are identical *un-*

* *Op. cit.* p. 127.

questionably with those floating on the fluid of the peritoneal cavity. The vessel may be readily isolated and placed detachedly under the eye of the microscope. The blood-corpuscles while in the vessel continue in ceaseless motion; this motion instantly ceases upon their escape from the vessel. Vibratile cilia may be actually *seen* on the internal lining membrane of the vessel: the motion is due to *their* vibration. Müller and Quatrefages and Dr. Peters incidentally refer to this phænomenon; by neither of these observers has it been referred to its true cause. In *no* other class of animals are the *internal* surfaces of true blood-vessels lined with cilia; it is because in the Echinoderms the blood-system is rudimentarily formed, that this aberrant phænomenon is intelligible. It is in the Echinoderms that the blood-proper system *first appears* in the zoological series. Nature's first effort is imperfect; the system is *not* independent of, closed off from, the other fluid systems of the organism; it derives its contents from those of the visceral cavity. The *water-vascular system* is exclusively locomotive and suctorial in function; it nowhere exhibits connexion with the branchial organs. Its fluid contents however indubitably communicate in some manner with those of the peritoneal cavity; the microscope *proves* them to be identical. In the Holothuridan genera these admit of more complete solution. In them the *three* systems exist under a pronounced form. The blood-system is more highly developed than in the inferior Echinoderms; it supplies branches to the tentacles, to the integuments, and forms a mesenteric plexus. The cavity of the body is notwithstanding filled by a highly corpusculated fluid, which penetrates into the hollow of the tentacles, and comes into near contact with the surrounding element through the *fenestræ* of the integument. In this genus then the *two* fluid systems are *separately* submitted to the process of aëration. The *parietes* of the tentacles bear a ramification of true blood-vessels. Their hollow axes are filled with chylaqueous fluid. But in the Holothuridæ a *fourth* system of fluids is superadded—that of the respiratory tree. The meaning of the respiratory tree is even now enigmatical; it consists of a cæcal, subdivided tube, filled with sea water, and communicating openly with the cloaca. *It floats in the fluid of the visceral cavity.* Its parietes are *not* supplied by a plexiform vascular system. The plexus formed by the blood-vessels lies in the folds of the mesentery, and belongs to the intestine; it exhibits no connexion with the *respiratory tree.* What then can be the signification of this excentric and paradoxical organ? Every comparative physiologist from Tiedemann to Müller has recognised in it a true respiratory organ; but in what possible manner can it accomplish such a function? The sea water admitted into its interior can-

not affect the true blood; its parietes are *not* supplied by blood-bearing plexuses. The latter are remotely situated. To what uses then is it dedicated? It is surrounded by, it floats in the mass of the chylaqueous fluid. From their relative positions, it is manifest that the fresh sea water admitted into the respiratory tree *either itself, or the air by which it is charged,* passes by endosmose through the partition of the parietes, and that the chylaqueous fluid in the closed visceral cavity, *either itself,* or the effete gases by which it becomes impregnated, passes out *into* the respiratory tree by exosmose. *This* is the real function of the "respiratory tree of the *Holothuria.*" It is an excentric apparatus artfully provided, to renovate the composition and replenish the volume of the chylaqueous fluid. Thus is presented a summary statement of the *mechanism* of respiration in the Echinoderms.

EXPLANATION OF PLATE XII.

Fig. 1. Plan in outline of an Asteroid Zoophyte: *a* & *d*, visceral cavity or space between stomach and exterior of the body in which the chylaqueous fluid is contained; *b*. shows the mode in which the tentacles are supposed by some observers to terminate in and open into the stomach itself; *c*, orifice at the bottom of stomach.

Fig. 2. Plan of Hydraform Polype: *a*, base of tentacle opening into the perigastric areolæ *c*; *b*, stomach.

Fig. 3. Actiniform Polype: *b*, visceral cavity; *a*, orifice at bottom communicating with this cavity; *c*, tubular base of tentacle; *d*, *cilia* lining the interior of tentacle.

Fig. 4. Plan of a Bryozoon: *a*, base of tentacle communicating with the visceral cavity *b*.

Fig. 5. Plan of *Rhizostoma* (*Medusa*): *b*, digestive sac; *d*, *c*, gastro-vascular canal.

Fig. 6. Horizontal plan of the same: *a*, centre of digestive sac *b*; *c*, *d*, gastro-vascular canals.

Fig. 7. Vertical plan of a Ciliograde Medusan, *Pleurobranchus*: *c*, *d*, gastro-vascular canals.

Fig. 8. Section of an arm of *Asterias*: *a*, mouth; *e*, opening from mouth into the digestive cæcum *b*; *c*, its further cæcal end; *h*, cavity or body filled with the chylaqueous fluid; *f*, *f*, membranous tubular and *cæcal* processes (the true *branchiæ* of the Starfish).

Fig. 9. Vertical imaginary section of *Echinus*: *a*, mouth; *b*, anus; *d*, visceral cavity; *e*, intestine; *f*, *f*, *f*, hollow membranous processes—the true branchiæ of the *Echinus*; *g*, suctorial processes.

Fig. 10. Head and neck of Sipuncle: *B*, transverse section of one of the branchiæ, ciliated within and without; *C*, the same, viewed transparently; *i*, coiled intestine; *h*, corpuscles of chylaqueous fluid; *m*, *j*, blood-vessel; *n*, visceral cavity.

Fig. 11. A piece of the skin of Sipuncle showing the *branchial fenestræ* *d*, *d*, *d*: *a*, a pigmented *epidermal* cell in the centre of the *un*pigmented area *b*; *c*, pigmented cells of the intervals between the fenestræ.

[To be continued.]

XXVI.—*Notes on the Ornithology of Ceylon, collected during an eight years' residence in the Island.* By Edgar Leopold Layard, C.C.S.

[Continued from p. 176.]

68. Piprisoma agile, Blyth.

I procured a single pair of these birds along the Central road, but know nothing of their habits.

69. Orthotomus longicauda, Gmel.

Everywhere common. It builds in broad-leaved shrubs; the nest is generally composed of cottony fibres mingled with horse-hair, and enclosed between two leaves whose edges are sown together with cobweb. I once saw a nest built among the narrow leaves of the oleander (*Nerium odorum*); it was constructed entirely of cocoa-nut fibre, and at least a dozen leaves were drawn into the shape of a dome, and securely stitched together, a small entrance being left at one side. The eggs usually are from three to five in number, of a greenish white colour, with reddish quadrangular blotches at the thick end. The favourite prey of this species is spiders, and their cheerful cry of "*pretty, pretty,*" may be heard at all hours of the day among the coppices, through which with elevated tails and abrupt jerking motions they hunt for them.

70. Cisticola omalura, Blyth, J. A. S. xviii.

I first discovered this species in 1847 in paddy fields near Galle, and subsequently found it sparingly about Colombo, and abundantly in the fields of *gingelle* (*Sesamum orientale*) at Pt. Pedro. When alarmed they drop down to the roots of the grasses, and are flushed with difficulty. Their flight is weak, and sustained by short jerks, and when on the wing they utter a faint but not unpleasing chipping note.

Dr. Kelaart says of this species, that "it is found in great abundance on Horton plains and Nuwera Elia, where they build their nests among the long patna grasses and reeds."

71. Cisticola cursitans, Blyth.

Is much less common than the preceding, and though found in the same locality, it frequents trees and jungle. Dr. Kelaart states he procured it abundantly at Trincomalie.

72. Drymoica valida, Blyth, J. A. S. xx. 180.

Peculiar to Ceylon. Discovered by myself in 1848, and described by Mr. Blyth in J. A. S. xviii. under the name of *D.*

robusta. It frequents tufts of grass and low bushes in dry situations. It is rather a rare bird, and feeds on small insects of all kinds, which it seeks amid the bushes. It generally hunts in small parties, and traverses the branches up and down in a similar manner to *O. longicauda.* The iris is a light red-brown.

73. Drymoica inornata, Sykes.

Is common about marshes; it builds among reeds, the tops of which it draws together into a dome over the nest. The eggs, generally four in number, are verditer with purplish blotches and wavy lines which increase in density at the obtuse end.

74. Prinia socialis, Sykes.

I obtained this species at Pt. Pedro in the fine grain fields; in habits it resembles *C. omalura.*

75. Acrocephalus dumetorum, Blyth.

Mr. Blyth identifies our Ceylon bird with this species, but it is a distinctly marked variety with a faint greenish shade upon all its plumage. It is not uncommon, widely distributed, and to the best of my knowledge, migratory.

76. Phyllopneuste nitidus, Blyth, J. A. S. xii. 965.

Migratory; appearing in Colombo in October, and frequenting all kinds of jungle. Its iris is dark hair-brown.

77. Phyllopneuste montanus, Blyth.

Mr. Blyth, in his Catalogue of the Birds in the Museum of the Asiatic Society of Bengal, gives the Himalayas as the habitat of this species; I procured it on the low plains of Pt. Pedro, where also another Himalayan bird, *Lanius erythronotus,* Vigors, is common. The present species is migratory, and abounds in low thick bushes in company with

78. Phyllopneuste viridanus, Blyth.

The irides of both are dark hair-brown.

79. Copsychus saularis, Linn. *Polichia,* Cing. *Caravy cooroovi,* Mal.; lit. Charcoal Bird.

This familiar household bird is called the "*Magpie Robin*" by Europeans, and the natives regard it with as much interest as we do our own red-breasted favourite, of which it is the Eastern representative. It is seldom seen away from habitations, about which it usually builds, though the nest is often placed in a thick bush

or hollow tree. The eggs, commonly four in number, are bright blue, thickly spotted with brown at the obtuse end. The food is insects of all kinds, and in all stages, captured on the ground and on trees. They have a variety of notes, and the song poured out in the fulness of their joy in the pairing season is very pleasing. On the top of a towering cotton-tree, opposite my last residence in Colombo, a magpie robin daily for some weeks charmed me with his song, whilst his mate sat brooding her eggs, or callow nestlings, in the roof of a native hut beneath him. One morning, after the young had left their cradle and betaken themselves to the neighbouring compounds, I was attracted by cries of distress from various birds and squirrels, and above all I heard the seemingly plaintive mewing of a cat. I had no *living* specimen of the last in my museum, so wondering what could be the matter, went into my garden to see. I found the mewing proceeded from my friends the robins, who were furiously attacking something in a bush, whilst the birds and squirrels screamed in concert. There I found one of the young robins, whose plumage by the way at that early age much resembles that of the European bird, being brown speckled with yellow, caught as I thought in the tendrils of a creeper; I put out my hand to release it, when to my surprise I saw the glittering eyes of the green whip snake (*Trimesurus viridis*, Lacép.), in whose fangs the bird was struggling. I seized the reptile by the neck and rescued the bird, but too late; it lay panting in my hand for a few moments, then fluttered and died. On skinning it I found no wound, except on the outer joint of the wing by which it had been seized, and am confident that fear alone deprived it of life.

A favourite attitude of this species is standing, with the tail elevated over the back, either perpendicularly or thrown so much forward as to nearly touch the head, the wings drooping; in this position they only utter a low note. Swainson has described as *Gryllivora rosea* a bird of this species; it is probably nothing more than one whose feathers were stained by the dust of our red kabook soil. During the long dry season some of our birds become so discoloured with this that they are useless as specimens.

80. Copsychus macrourus, Gmel.

The first time that I fell in with this exquisite songster will ever be impressed on my memory as connected with the beauties of tropical scenery. I arrived at Kandy one evening, and started the next morning collecting, and by chance took the road round the hill at the back of the Pavilion, called "Lady Horton's Walk." A few birds, which though common there, were rare in the Southern Province, had rewarded my labour.

The morning air was deliciously cool and bracing, both from the altitude and a shower of rain that had fallen over night, and I walked joyously along, delighted with my birds, and the luxuriant vegetation around me; at length under a bank I saw a fine shell, then new to my collection; my attention was thus confined to the side of the road in hopes of finding another, and unconsciously I reached a bend at the summit of the hill. Here a singular scene presented itself. I stood on the edge of an abrupt descent; at the bottom of this, stretched like an ocean, lay a thick fog bank, through which the tops of some lofty cocoanut trees here and there appeared, like beacons marking the site of submerged villages; all was silent, save that the occasional voice of some denizen of the grove showed that the feathered tribes were awakening. Suddenly the sun broke forth in its splendour, and with it a light breeze sprung up, the fog seemed endued with life, and heaved and rolled in noble masses; presently it rose a little and moved away down the valley melted into air, and a glorious landscape burst upon me. Below, meandering like a silver ribbon through the rich green patnas, wound the Mahavilla Ganga; here brawling over rocks, it fell in mimic cascades whitening the surface with foam, or flowing stilly, its darkness betrayed its depths. Far away stretched a noble expanse of patna, broken occasionally by belts of forest, and dotted with small clumps or isolated trees, till it was bounded by a lofty range of mountains, whose tops glowed in the light of the morning sun as if bathed in flame. Behind me and on the ledge where I stood, some gigantic forest trees reared their heads, their aged trunks covered with ferns and air plants. Immediately below my feet, reaching to the river, stretched a dense mass of foliage, relieved here and there by the graceful feathery branches of the areka or jaggery palm, or the vast leaves of the talipat. All nature seemed to awake—the woodlands resounded with the cooing of doves and the voices of hidden songsters. The green and yellow and red lizards (*Calotes viridis* and *versicolor*) crept up the topmost sprays of the bushes and sunned themselves, while the heavy flight of the gorgeous black and yellow butterfly (*Papilio darsius*), dipping into the mingled flowers which tempted it, contrasted pleasingly with the light and airy floating of the sombre-hued sylph butterfly (*Hestia hyblea*). I gazed with delight upon a scene so fair and so congenial to the eye of a field naturalist, till, unpleasantly reminded by a sharp pricking about my legs, that I stood too near the grassy margin of the road and was in the midst of land leeches, who delight in blood and not in scenery, I was covered with them, having forgotten my leech gaiters, and had no resource but to retreat to a large stone, and pick them off as well

as I could. So employed, I remarked that one of the songs which so charmed me was new; it came from a dark part of the jungle, and regardless of the tormenting leeches, I crept in on hands and knees, and peering about discovered a lovely bird, with two long and broad tail-feathers, piping most sweetly. Poor thing! its melody caused its destruction, and as its bright eye became dim, I thought there were many kinds of blood-seeking land leeches in this world.

Often since, but only in dense jungles and at early morn, or amid the lengthening shadows of evening, have I heard the clear note of the *Copsychus*, and that lovely scene has recurred to me in vivid distinctness.

81. Pratincola caprata, Blyth.

I procured specimens of this bird at Ambegamoa, and Dr. Kelaart includes it in his list as "found in the lower parts of the Kandian country."

82. Pratincola atrata, Kelaart.

Of this species Dr. Kelaart writes,—"Confined to the highlands; we have not met with it on lower hills than Rambodde. It is very numerous on the plains of Nuwera Elia, sometimes seen in pairs and often singly. The male bird perches on a twig of a small plant, or on a reed, and the female on the ground not far off; but rarely more than two or three pairs are seen in the same locality. They frequent gardens and flower-beds in search of insects."

I procured a pair at the foot of Adam's Peak.

83. Calliope cyana, Blyth.

A few specimens procured at Pt. Pedro, in passage, about the middle of October 1851.

84. Thamnobia fulicata, Linn. *Cary cooroovi*, Mal.; lit. Black Bird.

This is another of our household favourites, frequenting equally the Governor's palace and the native hut. It is never seen in the unfrequented jungle, but like the cocoa-nut tree, which the Cingalese assert will only flourish within the sound of the human voice, is found about the habitation of man. It feeds on insects of all kinds, and like its congener the magpie robin, sits much upon house-tops or fences, with its tail elevated, and utters a pleasing song. I have procured their nests, which are composed of hair, mosses and dry grasses, in the months of June and July

in Colombo, in December and April in the north. The eggs are from three to five in number.

85. Cyanecula suecica, Linn.

I procured a few specimens at Ambegamoa in the month of March, but have not seen them elsewhere.

86. Sylvia affinis, Blyth.

I noticed a few of this species at Ambegamoa in the year 1848, but I never afterwards met with it.

87. Parus cinereus, Vieill.

This titmouse is not uncommon throughout the island; its habits resemble those of our own well-known bird, hunting in small parties, and flitting from tree to tree.

88. Zosterops palpebrosus, Temm.

The "*white eye*" is common in the southern and midland districts, but rare towards the north. It is usually found in small parties creeping about blossoming trees, examining the flowers where it finds its food. It builds a cup nest fixed in the fork of two branches.

Dr. Kelaart includes—

89. Zosterops annulosus, Swains.,

among the birds he procured in the hills, but writes, "We fear that the Nuwera Elia *Zosterops* is wrongly identified. It is of a darker green than the common *Z. palpebrosus*." I however much doubt the distinctness of this and the preceding, and also of the two succeeding species.

90. Iöra Zeylanica, Gmel. *Kirikahaye* and *Ca-cooroolla*, Cing.; lit. Yellow Bird (being also the native designation of the two preceding species). *Mam-palla-cooroovi*, Mal.; lit. Mango Fruit Bird, from its colour.

Is extremely abundant, generally found in pairs creeping about trees. The note of this pretty little bird is a clear bell-like whistle, which may be imitated on an octave flute.

91. Iöra Typhia, Linn.

If this is really distinct from *I. Zeylanica*, we also have it, and in the same localities.

92. Motacilla boarula, Linn.

Of this I have seen but two specimens, and those I shot off the summit of an American cork-wood tree, in the Botanical Garden at Kew, on the Colombo Lake. However, Dr. Kelaart writes, "that it is generally seen on the highland patnas."

93. Motacilla Indica, Gmel. *Gomarita,* Cing.; lit. Dung-spreader.

This elegant little bird is frequently met with in shady places where cattle have been. They scratch among the ordure in search of the larvæ of insects, hence their native name. Migratory.

94. Motacilla Madraspatana, Briss.

I detected a single specimen in a collection of birds formed by F. W. Gisburne, Esq., C.C.S., in the Jaffna Peninsula. I do not know the exact locality where it was killed, but believe it to have been in the island of Valenny.

95. Budytes viridis, Scop.

Common on all open grass land, either in the mountainous or lowland districts. It is migratory, visiting us about the end of October and staying till May.

96. Anthus Richardi, Temm. *Pullu puraki,* Mal.; lit. Worm Picker,—a name common to all the genus and to the *Alaudinæ.*

Common and widely distributed, affecting low pasture lands. They rise in the air to a slight altitude, and sing like the European skylark (but not so sweetly) and return to perch on low bushes. In common with all our Pipits, they feed on small grubs and worms.

97. Anthus rufulus, Vieill.

Is far more abundant than the last and is found in large open plains, whilst *A. Richardi* prefers the vicinity of trees. It breeds in May, in a small depression of the soil or tuft of grass, slightly lined with dead fibres; the eggs, usually five in number, are of a verditer ground, freckled with minute brown spots.

98. Anthus striolatus, Blyth, J. A. S. xvi. 435.

According to Dr. Kelaart is very common at Nuwera Elia. I obtained a few specimens at Gillymally, on the lovely open plain where the village is situated.

99. Brachypteryx Palliseri, Kelaart.

One of the novelties added by Dr. Kelaart to our Ceylon fauna; he obtained it at Nuwera Elia and Dimboola; it is however rare.

100. Drymocataphus fuscocapillus, Blyth.

This genus was established by my friend Mr. Blyth for the reception of a small bird, of which but two specimens fell under my notice. One I killed with a blow-pipe, in my garden in Colombo, the other I shot in the Central road; their stomachs contained insects. The birds crept about bushes and shrubs like *Dumetia albogularis*. Mr. Blyth's description and remarks are as follows: "Like *Dr. nigrocapitatus*, but the supercilia, uniform with the lores; ear-coverts, sides of neck, throat, and entire under-parts, pale ferruginous brown, a little deeper on the breast; coronal feathers dark brown, margined with dusky black and pale striped, rest of the upper parts uniform grayish olive-brown; the primaries margined paler and the extreme tips of the tail-feathers rufescent; bill pale, the upper mandible dusky; feet pale. Length about $6\frac{1}{4}$ in., the wing $2\frac{7}{8}$ in., and tail $2\frac{1}{2}$ in.; bill to gape $1\frac{3}{16}$ in., and tarsi 1 in."

101. Alcippe nigrifrons, Blyth.

Peculiar to Ceylon and widely distributed. I discovered it in 1848. It frequents low impenetrable thickets, and its curious note often betrays its propinquity, when itself is closely hid. The irides are pale straw colour, and an egg which I took from the abdomen of the bird in the month of June was pinkish, spotted with dark purple.

Of this species Mr. Blyth says, "Closely affined to *A. atriceps*, Jerdon, from which it differs in not having the whole crown black, but only the forehead continued as a line backward over each eye and the ear-coverts. The tail also is darker and distinctly rayed with dusky black. General hue fulvous brown above and on the flanks and lower tail-coverts; rest of the under parts pure white, the axillaries tinged with rufescent. Wing $2\frac{1}{4}$ in."

102. Pitta brachyura, Jerd. *Tota collan*, Mal.; lit. Garden Thief. *Avitchīa*, Cing., from its cry, which the syllables pronounced slowly and distinctly, thus *A-vitch-ī-a*, much resemble.

This lovely ant thrush is very common, but more often seen than heard. It is wary and shy in its habits, and frequents

tangled brakes and the ill-kept native gardens. It preys much upon ants and resorts to the same hill for days together. It seldom alights on trees, only perhaps when alarmed, but keeps exclusively to the ground, or to the lowest branches of the underwood. It is migratorial, preceding the snipe in its arrival and departure.

103. Oreocincla spiloptera. *Val-avitchīa*, Cing.; lit. Wild Avitchī. Blyth, J. A. S. xvi. 142.

Peculiar to Ceylon and only found in the hilly zone, affecting high trees. I procured a specimen or two, both at Ambegamoa and Gillymally. Dr. Kelaart does not appear to have met with it at Nuwera Elia, for though he includes it in his catalogue, he does so on the authority of Mr. Blyth. Dr. Templeton discovered this species.

104. Merula Wardii, Jerdon,

and

105. Merula Kinnissii, Kelaart.

Neither of these have fallen under my immediate notice. Dr. Kelaart procured the first at Dimboola and the second numerously at Nuwera Elia. Mr. Mitford shot one (the only animal life he saw there) at the very summit of Adam's Peak, feeding on the crumbs of rice thrown out by the pilgrims as an offering to Buddha; and when Mr. Thwaites, the Superintendent of the Botanical Gardens, botanized on the Peak, he also saw a bird there, though it was much too soon for the pious offerings. Male jet-black, with orange-coloured legs, bill, and cere surrounding the eye. Female ashy; bill and feet yellow. Length 9 in.; of wing $4\frac{1}{2}$ in.; tail 4 in.; bill to gape $1\frac{1}{8}$ in.; tarsi $1\frac{1}{8}$ in.

106. Garrula cinereifrons, Blyth.

Another addition to our fauna by Dr. Kelaart. I do not know where he found it, but I obtained several specimens along the banks of the Calloo Ganga, about forty miles inland from Caltura, and one at Pallabaddoola, close to the source of the river in the Peak range. In habits it much resembles the *Malacocerci*, hunting in small parties and incessantly calling to each other. In the stomachs of those I examined were grubs, small snails, coleoptera and seeds. Affined to *G. Delesserti* of the Nilgiris, but differing much in its colouring. General hue a rich brown above, much paler below; forehead and cheeks pure ashy; chin and borders of the outer primaries albescent; bill blackish; legs dusky corneous. Length $8\frac{1}{2}$ in.; of wing $4\frac{1}{2}$ in.; tail 4 in., the outermost feathers $1\frac{1}{8}$ in. less; bill to gape $1\frac{1}{4}$ in.; tarsi $1\frac{1}{4}$ in.

107. Pomatorhinus melanurus, Blyth, J. A. S. xvi. 451.

I long considered this one of our rarest birds, and had but a single specimen which I obtained from a native. However, going on duty, a few miles from Colombo, on the road to Kandy, in the low, scrubby and almost impenetrable brushwood, growing on the chenas which had fallen out of cultivation, I found these birds in abundance in small parties of six or eight, their singular churring cry resounding in all directions. I also found it in the Balcadua Pass, and Dr. Kelaart at Nuwera Elia. They creep about bushes like the *Certhiadæ*, and feed on insects.

108. Malacocercus griseus, Gmel.

Included by Dr. Kelaart in his list, sed non vidi.

109. Malacocercus Bengalensis, Briss. *M. striatus*, Swains. *Demalichia*, Cing. *Punil*, Mal. *Pastru bragaru*, Port. Mud Bird, English.

This is one of our commonest birds, frequenting the road-sides and scratching among fallen leaves and the ordure of animals for its insect prey. They are always seen in small parties varying from three to seven, according to the number of young ones in a nest, which seem to remain with their parents until the period of incubation again commences, when they separate to form families of their own. When alarmed an old bird utters a piping note, making several prodigious hops, and takes to flight; his example is followed by all the rest in succession, and the whole party wing their way in a long file, alternately beating the air with heavy strokes, or sailing along on their rounded wings to a place of safety. Their nest is composed of fibres (generally those of the cocoa-nut husk), and placed in low bushes. So loosely is the structure put together that the eggs are plainly visible through it; they are of a perfect oblong and of a lovely blue verditer colour.

110. Malacocercus rufescens, Blyth, J. A. S. xvi. 453. *Kalaparandal*, Cing.

This new species of *Malacocercus* was discovered by Dr. Templeton, R.A., and described *loc. cit.* It is peculiar to the island and confined to the southern and midland districts, in thick jungle only. In habits it resembles the preceding species, but conceals its nest with so much care, that I never succeeded in obtaining information about it, even from the natives. The iris is white, and the cere round the eye, of the bill and of the legs, is a bright orange-yellow.

111. Dumetia albogularis, Blyth, J. A. S. xvi. 453.

Confined to the vicinity of Colombo and not uncommon; it is generally found in small flocks about the cinnamon and other low bushes, creeping about in search of insects.

112. Chrysomma Sinense, Lath.

This bird, or a pale variety, is not unfrequent near Caltura and in the Pasdoom Corle. I also observed a few specimens in the Anarajahpoora Wanny.

It hunts in small flocks about low bushes.

[To be continued.]

XXVII.—*Remarks on the Lias at Fretherne near Newnham, and Purton near Sharpness; with an Account of some new Foraminifera discovered there; and on certain Pleistocene Deposits in the Vale of Gloucester.* By the Rev. P. B. Brodie, M.A., F.G.S.*

I am afraid that the few observations I have to offer on the strata and fossils at Fretherne Cliff will present little novelty or importance; still there are a few points of interest to which I wish to draw the attention of our Members, and which seem to deserve a short notice. The Lias here rises in the shape of a low cliff at the end of a round hill between Saul and Arlingham. You are aware that the Severn in its course below Longney makes a great curve, so that the low lands in this district are bounded on three sides by the river, but the generally flat aspect of the scenery is relieved by the picturesque and bold outlines of the Oolitic hills on the east and south-east, and the Palæozoic system of May Hill and the Forest of Dean on the west and north-west. There are several cliffs on the banks of the Severn where the Lias is exposed between Gloucester and Aust Passage. Westbury is, I believe, the first of these below Gloucester, which I have already described (Fossil Insects, p. 58), but most of them exhibit the lowest beds of the Lias resting on the Red Marl, and contain a peculiar and on the whole distinct assemblage of organic remains. To this Fretherne and Purton form an exception, as the small sections exposed there consist of the lower Lias overlying the "Ostrea bed," equivalent to certain other portions of the series in the Vale of Gloucester, as at Hatherly, the Leigh, Piffs Elm, Hardwicke, &c. The upper part of the former cliff is composed of several layers of grayish white and blue lime-

* Read to the Cotteswold Naturalists' Club (Meeting at Sharpness), May 3, 1853.

stone, often nodular, divided by clay; and contains numerous fossils, viz. the characteristic *Gryphæa incurva, Lima gigantea, Gervillia, Avicula, Pecten, Nautilus, Ammonites,* spines and plates of Echinoderms, and a few other shells. The lower bands present the usual alternations of blue limestone and shales, which are often loaded with broken joints of *Pentacrinites,* amongst which a few heads of the rarer *Pentacrinites tuberculatus* (Miller) have been met with. This cliff, however, is particularly interesting, from the occurrence of a new and fine species of the Brachiopod*, *Orbicula Townshendi* (named after the discoverer), and one of the Foraminifera which I lately found, and which Mr. Rupert Jones believes will prove to be a true *Nummulite*†. They occur in a particular part of the cliff near the centre, and seem to be confined to one or two bands of limestone, the weathered surfaces of which occasionally are covered with them, though, from the highly crystalline state in which these mimute fossils are preserved, it is extremely difficult to make out their internal structure. This is the first occurrence of this genus in England in any stratum older than the Eocene (Tertiary) group, and was hitherto supposed to be confined to the Tertiary series. Ehrenberg proved long ago that many of these minute organisms among the Foraminifera (which form so important a part in the composition of many rocks), from the Chalk upwards, had continued to exist even to the present day, while the contemporary forms of a higher order had become extinct, and we may therefore feel less surprise at the presence of a true *Nummulite* even so low down in the secondary series as the Lias, although we have no trace of the same genus again until a comparatively recent epoch, a wide interval of time having elapsed between its supposed first creation and its reappearance in profusion in the Tertiary series. So abundant are some of these fossils in some places abroad, that vast masses of tertiary limestone are entirely composed of them, and in the Lias at Fretherne they are generally grouped together in masses.

M. Bouvigny has lately described and figured a *Nummulite*‡ from certain Jurassic strata on the continent, namely the lower marls belonging to the *calcaire à Astartes,* which occurs between the Kimmeridge Clay and the Coral Rag. I had previously

* Mr. C. Moore has lately found several new species of *Brachiopoda* in the upper Lias in Somersetshire, and one very curious shell which he thinks may belong to a new genus, having two bosses at the side. Deslongchamps has also detected several new forms belonging to this order in the upper Lias of Normandy, amongst which is a *Leptæna* of large size; all those previously discovered by Mr. Moore near Ilminster being extremely minute. See Mr. Davidson's Monograph: Palæontographical Society.

† See Mr. Jones's Note, *infra.*

‡ *Nummulina Humbertina*: see Géol. statistique, minér. et paléont. de la Meuse; Atlas, p. 47. pl. 31. f. 32–35.

observed similar forms in the Lias near Down Hatherley, but was ignorant of their true characters, for which palæontologists are indebted to the investigations of the able Assistant Secretary of the Geological Society, Mr. T. R. Jones, who has already described new and interesting species of Foraminifera from various deposits. My friend Mr. C. Moore of Ilminster, a zealous and able collector and a good naturalist, informs me that although he has detected *fifty* new species of Foraminifera in the upper Lias and Marlstone of Somersetshire, he has never yet observed a *Nummulite*. The section at Purton is very small, but fossils are most abundant; it appears to be a little higher in the series than Fretherne Cliff, and is composed of clay and shale, in which are imbedded rounded blocks and nodules of blue limestone. *Gryphæa Macullochii* is very abundant, with *Pleurotomaria Anglica, Ammonites Bucklandi* (a fine specimen of which was discovered by Lord Ducie), a few of the *Nummulites* above referred to, and two other new and interesting species of Foraminifera. Some slabs of limestone are covered with many species of minute Univalves. It is at this spot that the Lias is succeeded by the Upper Ludlow rocks, which crop out on the banks of the Severn a little further to the west. I confess I have a great affection for the muddy Lias, as I am indebted to it for a rich store of insect remains. When I first came into this district, now twelve years ago, I carefully examined some of the beds of the lower Lias, belonging to the *middle* part of the formation in the neighbourhood of Gloucester, without success, and I was struck with the paucity of organic remains (which certainly are not numerous), although I have since then obtained a few rare and interesting fossils in them, especially elytra of Coleoptera, about three species of Corals, and Foraminifera having the appearance of *Nummulites*. After a time I visited Wainlode Cliff, where the basement beds of the Lias are exposed in a fine section resting on the Red Marl. There for the first time I discovered several wings and small wing-covers of Beetles in fallen fragments of limestone, which led me to search more closely, and the result has been a fine collection of wings, elytra, and a few entire insects from this division of the Lias, not only in Gloucestershire, but in Somersetshire, Worcestershire, and Warwickshire, where these insect beds are more or less extensively developed, and present many features of novelty and interest.

I subjoin a Note with which Mr. R. Jones has lately favoured me, since his renewed examination of these little fossils.

My dear Sir,

The following are the characters of the minute bodies in the Fretherne limestone, as far as I have been enabled to work

them out. They are discoidal, convex on both sides equally, $\frac{1}{24}$ inch in diameter, and $\frac{1}{48}$ inch thick in the centre. The surface is very coarsely granulated, excepting a narrow outside border on each face and the edge, which parts are but slightly roughened. The granulation in some specimens follows irregular wavy lines from the centre of the disc towards the border; in others it is arranged somewhat spirally around the centre; more generally, however, it covers the central space thickly and irregularly. Between the smooth border and the granulated central part is a slight, narrow depression, which is stronger in some specimens than in others. The edge is rather obtuse.

When sections and transparent slices of these little bodies are examined, the whole body is seen to be coarsely crystalline; but by means of lenses of different powers and under a strong microscope several important indications of structure may be recognized. The horizontal sections exhibit internal spiral walls (which are not, however, in the specimens I have yet manipulated, traceable to the very centre), together with short, straight, cross septa, which latter are very visible in a weather-worn specimen from Purton. In the vertical sections are seen, on each side of the median line, the vertical tapering "columns" (originating in the local difference of structure in the shell tissue), characteristic of the Nummulite group, and traces of the central horizontal row of chambers. A line of fracture traverses this series of chambers, and sometimes brownish patches stain the calc-spar along this line; but the shape of these chambers is not satisfactorily shown.

I have not yet been able to recognize the apertures of connexion between the chambers nor the aperture of the last outer chamber.

The horizontal median line of chambers, spirally arranged, the vertical "columns," and the superficial granulations (which are continuous with the internal "columns") are characteristic of the true Nummulite; but unfortunately we do not know whether the position of the apertures of the cells in this little fossil corresponds with that in the genus just referred to. Provisionally, however, it may be regarded as a Nummulite; and, should you see no objection, it may be termed *Nummulites*? *liassicus*.

This form essentially differs from M. Bouvigny's *Nummulina Humbertina*, especially in external character and in size.

The three *Stichostegian* Foraminifers from Purton are *Dentalinæ*, belonging to two species. In shape one of them is something like *D. pauperata* (D'Orbigny), and the other approaches *D. Lorneiana* (D'Orbigny). To describe and name these fossils without figures would not be advisable.

I may here add, that some years since I obtained from a specimen of Lias clay from Gloucestershire some minute fossils which may be enumerated with the above, viz. a *Cristellaria* and a *Vaginulina*, which were associated with the *Spirillina infima* and a few *Cytheres*.

I am, dear Sir, yours very truly,

T. Rupert Jones.

The Rev. P. B. Brodie, A.M., F.G.S. &c.

Sept. 21, 1853.

I must now draw your attention to certain gravel beds round Gloucester, which have not been sufficiently or accurately examined, and which I hope some of our Members will shortly undertake to do. They are evidently of different age; one of the most recent appears to be the alluvial deposits on the banks of the Severn, of which the following section in descending order affords an example, and was given me by Mr. Edwards, one of the engineers of the Gloucester and Chepstow Railway.

	ft	in.
Soil	1	0
Sand and red clay	10	8
Light blue clay	13	9
Peat	2	0
Red sandy clay	4	0
Brown sand	1	10
Rough gravel	7	8
Sand and gravel	2	0
Fine gravel	5	10
Hard blue marl	2	3
Total.....	51	0

The above section was taken close to the Severn at Westgate (Over) Bridge. No shells are mentioned, but the thickness of the deposit is worthy of notice. The gravel round Gloucester is mainly composed of rolled fragments of Oolite and debris of Lias, and was evidently derived from the Inferior Oolite and Lias adjacent. Some pretty Oolitic Corals may be found in it, and occasionally bones and teeth of Elephant, Horse and Deer, but these are very scarce. During the excavations for the Great Western Railway at Stroud, many fine remains of Elephant, Rhinoceros, Horse, Deer, and Ox were procured from the gravel, and several of these are now in the collection of our friend and colleague Professor Buckman. The summit of Wainlode Hill is capped by a bed of pebbles called the Northern Drift, and is chiefly made up of rolled and rounded pebbles of ancient rocks

and some flints, which have travelled from the north and north-east.

Another and very interesting deposit of gravel occurs in the neighbourhood of Westbury, which clearly owes its origin to the destruction of the Old Red Sandstone in the forest, and of the Silurian rocks of Huntley, May Hill, and Longhope adjoining. Among other things it contains many beautiful Corals from the Wenlock limestone. I had hoped to have been able to have investigated the Pleistocene formation generally in Gloucestershire, but unfortunately I have not had time to accomplish it, and I must therefore leave the task to abler and better hands. Of late these more modern accumulations have deservedly attracted the attention of geologists, and many interesting facts have been brought to light respecting them, and it is most desirable that they should be carefully examined and described in different localities.

As I am so shortly about to leave this neighbourhood, to my great regret, I may be excused, perhaps, in conclusion, for paying a parting tribute of regard to the geology of the district, to which I owe many days of health and happiness, and I can only say that I know of no other which presents so rich and important a field of research, or one wherein a diligent and active lover of science may reap a more productive or abundant harvest.

Within a circuit of twenty miles, nearly every formation, from the commencement of the lower Oolite down to the lower Silurian system, may be studied with comparative ease, and a good suite of fossils from each stratum may be collected. This, as many of you are well aware, comprises a very extensive series of rocks of vast extent and thickness, of great value in an œconomical point of view, and containing a varied and widely different fauna, by which we obtain a knowledge of the earth's history in past times, from one of the earliest ages up to a much more recent period.

The sorrow felt on leaving a neighbourhood so instructive in natural phænomena is increased by the loss of these pleasant meetings, and the parting with many scientific friends, whose companionship has added a charm and a zest to the studies of the closet and the more active labours of the field, and must ever afford a great encouragement in the pursuit of those noble ends and grand discoveries for which geology is so pre-eminently distinguished.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

July 22, 1851.—John Edward Gray, Esq., F.R.S. &c., Vice-President, in the Chair.

The following papers were read:—

1. On the largest known species of Phaleridine Bird. By Charles Lucien, Prince Bonaparte.

Among the new additions lately made to the British Museum I was struck by one of the *Alcidæ*, which I had never seen before, and which was very properly placed close by two beautiful specimens of my singular *Ceratorrhina*, also lately added to the zoological treasures of the English nation. The bird which is the subject of the present note is evidently the *Labrador Awk* of Latham, so miscalled from the erroneous impression that it came from those eastern shores of America, but too well described not to be recognized. Gmelin compiled his *Alca labradora* from the description of Latham, and all those who did not follow him blindly, have referred that indication to an immature state of the Razor-bill (*Mormon arctica*), a course in which they were led by geographical consideration only. Although our bird belongs to the family of the *Alcidæ*, it is not even an *Alcine*, as the Razor-bill, but, as is shown by the nakedness of the cere, it belongs to the other subfamily, or *Phaleridine*, of which it is at present the largest known.

In its family it is certainly allied to *Ceratorrhina*, but well deserving to constitute a genus by itself. The bill still more compressed, is in fact much more angulated beneath, and covered at the base, not by a bony process or *horn*, but by a soft membrane or *saddle*, which leaves a simple slit along the margins for the impervious nostrils.

Genus novum Phaleridinarum.

Sagmatorrhina, Bp. Saddle-Bill.

Rostrum duplo longius quam altum; maxilla ad basin recta cerâ maximâ induta, apice incurva; mandibula ultra medium statim adscendens, angulum obtusum constituens; nares lineares, marginales.

As the bird has been so well described by Latham, Mr. G. R. Gray very properly suggests that its specific name should be taken from that author.

Sagmatorrhina Lathami, Bp. *Maxima; nigricans; subtus albido-fuliginosa: rostro pedibusque rubris; cerâ palmisque nigris.*

Long. 16 poll.; rostr. 2 poll. long., 1 altum, $\frac{5}{8}$ latum ad basin, $\frac{3}{8}$ ad med.; alæ $7\frac{1}{2}$ poll.; cauda $3\frac{1}{2}$; tars. $1\frac{1}{4}$; digitorum longissimus $2\frac{3}{8}$.

This species is the largest of the subfamily, which is well known to contain the dwarfs of the Water birds; it is one-third larger than *Ceratorrhina monocerota*, of which it has precisely the colouring, wanting only (at least in the state we have it) the little white feathers above the eye and at the corners of the mouth. The proportions of wings, tail, feet and toes are the same: the bill and toes must have been reddish; the cere and membranes black. Like the *Ceratorrhina*, it seems to be confined to the North-western Arctic regions of America; and we are led to believe it does not extend to the Siberian shores, from the circumstance of its not having been noticed by Russian naturalists.

The well-marked family of *Alcidæ* forms, with the *Colymbidæ*, *Podicipidæ* and *Spheniscidæ*, the great section of the *Urinatores*, which, with the *Lamellirostres*, constitutes alone the Order *Anseres*, as it must be restricted to the *web-footed Præcoces* of Prof. Owen. The other two sections, *Longipennes* and *Totipalmi*, constitute now the Order *Gaviæ* of my Conspectus, being, in fact, *web-footed Altrices*, which have no more right to remain in *Anseres* than the *Pigeons* among the *Gallinæ*,—than the *Herodiones* among the *Grallæ*. The passage between my *Gaviæ* or *web-footed Altrices*, and my *Herodiones* or *grallatorial Altrices*, is beautifully exemplified by that most remarkable bird the *Balæniceps*, whose affinity with *Pelecanidæ* has so well been pointed out, and even exaggerated, by Mr. Gould. On the other hand, it is no less obvious that the *Longipennes*, some of which, with tumid bills, have been considered as *Sea-Pigeons*, connect them (the *Gaviæ*) with the *Columbæ*; whilst between the two subclasses the connections and correspondence (affinity and analogy) take place in different degrees and by different means and sides, chiefly as exemplified in the following table:—

AVES.

1. ALTRICES (Insessores).
   1. Psittaci.
   2. Accipitres.
   3. Passeres.
      a. Oscines.
      b. Volucres.
   4. Columbæ.
      a. Inepti.
      b. Gyrantes.
   5. Gaviæ.
      a. Totipalmi.
      b. Longipennes.
   6. Herodiones.

2. PRÆCOCES (Grallatores).
   7. Grallæ.
      a. Alectrides.
      b. Cursores.
   8. Struthiones.
   9. Gallinæ.
   10. Anseres.
      a. Lamellirostres.
      b. Urinatores.

2. A Monograph of Scutus, a genus of Gasteropodous Mollusca, belonging to the family Fissurellidæ. By Arthur Adams, R.N., F.L.S. etc.

Genus Scutus, De Montfort.

Animal with the head proboscidiform; tentacles thick and subulate, with the eyes on tubercles at their outer bases; mantle reflexed over the sides of, and nearly covering, the shell; sides of foot with a series of short cirrhi.

Shell oblong, scutiform, flattened; apex dorsal, oblique, posteriorly inclined; margin of aperture sinuated in front; muscular impression horse-shoe shaped, open anteriorly.

Parmophorus, Blainv.—*Dascinus*, Rafin.—*Scutellites*, Auct.—*Scutum*, Sow. jun.—*Parmophora*, Desh.—*Emarginula*, sp. Sow.—*Patella*, sp. Lamk.

1. Scutus unguis, Linn.

Patella unguis, Linn. Mus. Ludovic. Ulric. Regin. p. 69. no. 419.—*Patella ambigua*, Chemn.—*Scutus antipodis*, Montf.—*Parmophorus australis*, Lamk.—*Parm. elongatus*, Blainv.

Hab. New Zealand. Mus. Cuming.

2. Scutus elongatus, Lamarck.

Patella elongata, Lamk. Ann. du Mus. i. p. 310.—*Parmophorus elongatus*, Lamk. Hist.—*Emarginula elongata*, Sow. Gen.

Hab. East Australia. Mus. Cuming. Also occurs fossil.

3. Scutus granulatus, Blainv.

Parmophorus granulatus, Blainv. Bullet. des Scienc. 1817; Lamk. Hist. An. s. Vert. vol. vii. pt. ii. p. 5; Reeve, Conch. Syst. pl. 139. f. 4.

Hab. Port Essington, on the rocks, low water. Mus. Cuming.

4. Scutus corrugatus, Reeve.

Parmophorus corrugatus, Reeve, Proc. Zool. Soc. 1842; Conch. Syst. pl. 139. f. 1.

Hab. ——? Mus. Cuming.

5. Scutus tumidus, Quoy et Gaimard.

Parmophorus tumidus, Quoy et Gaim. Voy. de l'Astrol. pl. 69. f. 6.—*Parm. gibbosus*, Anton.—?*Parm. breviculus*, Blainv. Bull. des Sci. 1817; Sowerby's Gen. (Emarg.) fig. 2.

Hab. Madagascar. Mus. Cuming.

6. Scutus imbricatus, Quoy et Gaimard.

Parmophorus imbricatus, Quoy et Gaim. Voy. de l'Astrol. pl. 69. f. 17, 18.

Hab. Island of Burias. Mus. Cuming.

7. Scutus angustatus, A. Adams. *S. testâ elongatâ, subquadrangulari, lateribus angustatis, coarctatis; dorso plano, concentrice striato, vertice subcentrali, postice declinato; extremitate anticâ sinuatâ, posticâ excurvatâ, subelevatâ.*

Hab. Eastern Seas. Mus. Cuming.

3. A Monograph of the genus Monoptygma of Lea. By Arthur Adams, R.N., F.L.S. etc.

Genus Monoptygma, J. Lea. (? *Menestho*, Müll.)

Animal unknown.

Shell subulately turreted, transversely striated, apex simple, acute; aperture oval, longer than wide, rounded and entire in front; columella with a single oblique fold.

This genus differs from *Actæon* in being elongated, and in having an oblique fold, instead of a transverse plait on the columella.

1. Monoptygma striata, Gray. *M. testâ turrito-subulatâ, solidâ, olivaceâ, anfractibus planis, transversim sulcatis, sulcis profundis, distantibus; aperturâ oblongâ, intus albâ.*

This species, which is typical, is a very thick and strong shell, with a somewhat convex lateral outline, and strongly transversely grooved across the flattened whorls. Mus. Cuming.

2. Monoptygma fulva, A. Adams. *M. testâ turrito-subulatâ, graciliori, solidâ, fulvâ, anfractibus planis, transversim sulcatis, sulcis profundis, distantibus; aperturâ oblongâ, intus fuscâ.*

This elegantly-formed shell is more slender than *M. striata*, and of a different colour; the transverse grooves are also much closer together, and their edges are rounded; the twist of the columella is not so distinct, and the aperture is brown internally. Mus. Cuming.

3. Monoptygma granulata, A. Adams. *M. testâ ovato-turritâ, albâ, solidâ, anfractibus planiusculis, gradatis, longitudinaliter corrugato-plicatis, transversim sulcatis, sulcis profundis, valde distantibus; interstitiis lævibus; aperturâ oblongâ, columellâ plicâ subproductâ.*

This is a rather short and obtuse white and solid species, very strongly grooved transversely, and with the whorls longitudinally corrugately plicated. Mus. Cuming.

4. Monoptygma lauta, A. Adams. *M. testâ turrito-subulatâ, albidâ, tenui, subpellucidâ, anfractibus planiusculis, longitudinaliter eleganter striatis, transversim sulcatis, sulcis distantibus, interstitiis crenulatis; aperturâ oblongâ, columellâ obliquâ et curvatâ.*

A very beautifully-sculptured species, dredged from 10 fathoms, at Bolinao, by Mr. Cuming; the outline is subulated, and the whorls rather flattened and longitudinally striated. Mus. Cuming.

5. Monoptygma amœna, A. Adams. *M. testâ ovato-acuminatâ, tenui, subpellucidâ, albidâ, longitudinaliter substriatâ, anfractibus convexiusculis, transversim sulcatis, sulcis valdè distantibus, interstitiis eleganter punctatis; aperturâ oblongâ, antice dilatatâ, columellâ rectâ.*

This is a most exquisite species, both in form and sculpture; the whorls are rounded and punctate-striate, and the shell is nearly pellucid; it is from Bolinao, 10 fathoms water. Mus. Cuming.

6. Monoptygma casta, A. Adams. *M. testâ ovato-turritâ, albâ, tenui, semipellucidâ, anfractibus convexiusculis, transversim sulcatis, sulcis subconfertis, interstitiis pulcherrimè striatis; aperturâ oblongâ, antice productâ, columellâ obliquâ, subtortuosâ.*

This pure white ovate form is from the China Seas, being collected by the writer during the Voyage of H.M.S. Samarang. The whorls are grooved, with the interstices striated. Mus. Cuming.

7. Monoptygma speciosa, A. Adams. *M. testâ turritâ, subulatâ, albidâ, tenui, semipellucidâ, anfractibus octo, convexiusculis, suturâ profundâ, cingillis transversis elevatis, interstitiis concinnè cancellatis, ornatâ; aperturâ oblongo-ovali, columellâ subrectâ, supernè plicâ obliquâ subobsoletâ instructâ.*

Hab. Baclayon; Philippines. Mus. Cuming.

An elegant semipellucid species, resembling an elongated *Actæon*, with the whorls encircled with elevated cingilli, and the interstices cancellated.

8. Monoptygma spirata, A. Adams. *M. testâ turritâ, albâ, epidermide fusco tectâ, anfractibus octo, planiusculis, gradatis, suturâ canaliculatâ, plicis longitudinalibus, angustis, confertis, et sulcis transversis decussatim ornatâ; aperturâ oblongâ, labio plicâ unicâ obliquâ instructo.*

Hab. Camaguin; Philippines. Mus. Cuming.

A small turreted species, covered, in the living state, with a light brown epidermis, and with the surface regularly and beautifully decussated with raised lines.

9. Monoptygma tenella, A. Adams. *M. testâ ovato-turritâ, albâ, subpellucidâ, anfractibus quatuor, convexiusculis, transversim tenuiter striatâ; aperturâ ovali, labio subreflexo, plicâ obsoletâ instructo; labro dilatato, margine flexuoso incrassato et subreflexo.*

Hab. Philippine Islands. Mus. Cuming.

A small *Rissoa*-like shell, with only a faint indication of a plait on the columellar lip; the aperture dilated, and the outer lip expanded and slightly thickened anteriorly.

10. Monoptygma stylina, A. Adams. *M. testâ subulatâ, in medio incrassato, albâ, subpellucidâ, anfractibus* 9–12, *planiusculis, transversim tenuiter sulcatâ, longitudinaliter substriatâ; aperturâ oblongâ, labio superne plicâ obliquâ instructo; labro, in medio, subrecto.*

Hab. Catanuan; Philippines. Mus. Cuming.

A remarkable white subulate shell, with the middle whorls, especially those near the apex, enlarged.

11. Monoptygma suturalis, A. Adams. *M. testâ subulato-turritâ, subumbilicatâ, albâ, nitidâ, subdiaphanâ, anfractibus septem planis, suturâ canaliculatâ, transversim sulcatâ, an-*

fractu ultimo subsoluto, fasciis angustis, albo articulatis, ornato; aperturâ oblongo-ovali, labio plicâ evanidâ instructo.

Hab. Philippine Islands. Mus. Cuming.

A small white species, with the last whorl nearly free, and having the suture deeply channeled.

4. Descriptions of new Shells, from the Cumingian Collection; with a Note on the genus Nematura. By Arthur Adams, R.N., F.L.S. etc.

Pyramidella metula, A. Adams. *P. testâ subulatâ, turritâ, apice obtusiusculo, albidâ anfractibus decem planulatis, longitudinaliter costatâ, costis confertis æquantibus, interstitiis lineis transversis elevatis ornatâ; aperturâ ovali, labio incrassato, in medio plicâ unicâ instructo; labro margine subincrassato.*

Hab. Mizamis, Cagayan. Mus. Cuming.

A small elongated species, somewhat resesembling a *Rissoina*, with the intervals between the ribs finely cancellated, and the whorls very numerous.

Pyramidella aclis, A. Adams. *P. testâ subulatâ albâ nitidâ, anfractibus octo planiusculis longitudinaliter plicatâ, plicis æqualibus subconfertis, interstitiis lævibus; aperturâ semiovatâ, labio subincrassato plicâ unicâ munito; labro subdilatato.*

Hab. Philippines. Mus. Cuming.

This is a slender subulate species, likewise resembling in appearance a *Rissoina*.

Lacuna carinifera, A. Adams. *L. testâ ovatâ, spirâ acuminatâ, anfractibus quatuor, latè umbilicatâ, fulvâ, anfractu ultimo angulato, carinâ transversâ elevatâ, rufo-fusco articulatâ, ornato; aperturâ semiovatâ; labro acuto, angulato, labio recto, fissurâ umbilicali elongatâ.*

Hab. Borneo. Mus. Cuming.

The single prominent keel round the periphery of the last whorl is the principal feature of this species.

Velutina Sitkensis, A. Adams. *V. testâ nigro-fuscâ, epidermide liris elevatis transversis confertis obtectâ, longitudinaliter valdè sulcatâ, sulcis subdistantibus; aperturâ ovali, intus sulcatâ; labro margine reflexo, nigro, incrassato; postice nonproducto supra anfractum ultimum.*

Hab. Sitka. Mus. Cuming.

The dark brown colour and oval form distinguish this species from *V. lævigata*, which also has the outer lip arched and expanded posteriorly.

Otina fusca, A. Adams. *O. testâ magnâ, solidâ, semiopacâ, fuscâ, sine epidermide, dorso convexâ, longitudinaliter subplicatâ, transversim tenuiter striatâ, labio lato, plano, et excavato; labro recto, non reflexo aut expanso.*

Hab. Benguela. Mus. Cuming.

The large size of this species, and its convex form, distinguish it from *O. otis*, and its absence of bands, and the outer lip not being expanded, from *O. zonata*, Gould, the only two species at present known to me.

5. Note on Nematura, by A. Adams.

The genus *Nematura*, established by Mr. Benson, appears to have the closest affinity with *Bithynia* of Leach, but the horny operculum, with grooved margins, and the contraction of the aperture, will distinguish them. There appear to have been found at present but six species, three of them known, and three here indicated for the first time; in the rivers and streams of the East are doubtless many more; they are usually found adhering to the under surface of dead floating leaves.

1. Nematura Deltæ, Benson. *N. testâ magnâ, pallidè fulvâ, globosâ, lævi; aperturâ orbiculari, peritremate simplici.*
Mus. Cuming.

2. Nematura minima, Benson. *N. testâ parvâ, corneâ, semipellucidâ, ovali, spirâ subproductâ; politâ, fasciis rufis subobsoletis ornatâ; aperturâ orbiculuri, peritremate simplici.*
Mus. Cuming.

3. Nematura polita, Sowerby. *N. testâ magnâ, castaneo-fuscâ, compressâ, subvaricosâ; aperturâ ovali, peritremate anticè striato; regione umbilicali lirâ callosâ circumdato; punctato-striatâ.*
Mus. Cuming.

4. Nematura olivacea, A. Adams. *N. testâ ovatâ, opacâ, olivaceâ, viridi-fusco reticulatâ; aperturâ ovali, spirâ elevatâ, apice decollato, peritremate simplici.*
Mus. Cuming.

5. Nematura glabrata, A. Adams. *N. testâ magnâ, ovatâ, non compressâ aut varicosâ, subviridi-corneâ; spirâ acutâ, apice acuminato, lævi, politâ; aperturâ orbiculari, angustatâ, peritremate nigro.*
Hab. Penang. Mus. Cuming.

6. Nematura puncticulata, A. Adams. *N. testâ mediocri, pallidè fulvâ, compressâ, anfractu ultimo gibboso, et subangulato ad latera, lineolis punctatis transversis ornatâ, peritremate simplici.*
Hab. Eastern Islands. Mus. Cuming.

6. A Monograph of the recent species of Rimula, a genus of Mollusca, belonging to the family Fissurellidæ. By Arthur Adams, R.N., F.L.S. etc.

The genus *Rimula* of Defrance has been usually confounded with *Puncturella* of Lowe, or the *Cemoria* of Leach, but it is at once

distinguished by the absence of the arcuated plate in the interior of the vertex. The species already known are fossil, to which we now add a few recent examples.

Genus Rimula, Defrance.

Shell conical, with an elevated, recurved, entire vertex, turned towards the posterior end; surface cancellated, with radiating ribs; a linear perforation in the upper part of the shell, half-way between the vertex and anterior margin; margin of aperture crenulated; interior simple, with no shelly plate; muscular impression crescentic, interrupted in front.

1. Rimula exquisita, A. Adams. *R. testâ magnâ, ovali, semipellucidâ, albâ, costis longitudinalibus, radiantibus, lineisque elevatis, transversis, concentricis, cancellatâ; cancelli subquadrati; costis crenulatis, inæqualibus, prominentibus, anterioribus duabus divergentibus, interstitiis costellis duabus instructis; supra perforationem concavâ; perforatione elongatâ subquadratâ.*

Hab. Catanuan, island of Luzon and island of Burias, found on dead shells, 7 and 10 fathoms, sandy mud (*H. C.*). Mus. Cuming.

2. Rimula Cumingii, A. Adams. *R. testâ parvâ, ovatâ, opacâ, costellis longitudinalibus, radiantibus, lineisque transversis, crassis, concentricis, cancellatâ; cancelli transversi, elongati; costis nodulosis, subæqualibus, prominentibus, distantibus, anterioribus duabus antice divergentibus, interstitiis costellis duabus instructis, perforatione elongatâ, subquadratâ.*

Hab. Eastern Seas. Mus. Cuming.

3. Rimula carinata, A. Adams. *R. testâ parvâ, ovali, costellis simplicibus, permultis, confertis, longitudinalibus, radiantibus, ornatâ; interstitiis cancellatis; cancelli punctiformes; costellis duabus anterioribus, antice convergentibus, et apud aperturæ marginem junctis; interstitiis, supra perforationem, convexis, supra verticem extendentibus, quasi carinâ; perforatione ovali, angustâ, antice angustatâ.*

Hab. Cagayan, province of Misamis, island of Mindanao, on dead shells, 25 fathoms, sandy mud (*H. C.*). Mus. Cuming.

4. Rimula propinqua, A. Adams. *R. testâ parvâ, elongato-ovali; costellis prominentibus, asperis, longitudinalibus, radiantibus, subdistantibus; interstitiis valde cancellatis; cancelli transversi, subquadrati; costellis duabus anterioribus, antice convergentibus, ad aperturæ marginem junctis; perforatione angustato-ovali, antice acuminatâ.*

Hab. Catapan, Philippines. Mus. Cuming.

7. A Monograph of Puncturella, a genus of Gasteropodous Mollusca, belonging to the family Fissurellidæ. By Arthur Adams, R.N., F.L.S. etc.

Genus Puncturella, Lowe.

Head proboscidiform, tentacles subulate, with the eyes on swellings at their outer base; sides with a range of cirrhi, interrupted behind on each side; mantle-margin simple; branchial plumes two; anal siphon prominent, forming a truncated membranous canal projecting from the subapical perforation.

Shell conical, with an elevated, slightly recurved, obliquely spiral entire vertex, turned towards the posterior end; aperture expanded, oval; surface with radiating ribs; margin entire; a linear perforation in the upper part of the shell, between the vertex and front margin, in the line of an elevated rib. Interior with a linear groove, vaulted over with a shelly plate corresponding to the perforation; muscular impression crescentic, interrupted in front.

Cemoria, Leach, MSS.—*Sipho*, Brown.—*Rimula*, Lovèn; Gould; Couthouy.—? *Diadora*, Gray.

1. Puncturella Noachina, Linnæus.

Patella noachina, Linn. Mantissa, p. 551; Chemn. Conch. Cab. vol. xi. p. 186. pl. 197. f. 1927, 1928.—*Patella fissurella*, Müller.—*Fissurella Noachina*, Schum.—*Puncturella Noachina*, Lowe.—*Cemoria Flemingii*, Leach, MSS.—*Cemoria Noachina*, Lowe.—*Rimula Flemingii*, Macgill.—*Rimula Noachina*, Couthouy.—*Sipho Noachina*, Brown.

Hab. British Islands. Mus. Cuming.

2. Puncturella cucullata, Gould.

Rimula cucullata, Gould, Expedition, Shells, p. 14.
Hab. Puget Sound.

3. Puncturella galeata, Gould.

Rimula galeata, Gould, Expedition, Shells, p. 14.
Hab. Puget Sound. Mus. Cuming.

4. Puncturella cognata, Gould.

Rimula cognata, Gould, Expedition, Shells, p. 14.
Hab. Orange Harbour.

5. Puncturella conica, D'Orb. Voy. Am. Mer.

6. Puncturella fastigiata, A. Adams. *P. testâ albidâ elevato-conicâ, nitidâ, vertice acuminato involuto, costellis longitudinalibus æqualibus æquidistantibus, interstitiis planis lineis incrementi concentricis; fissurâ lanceolatâ; aperturâ ovali, margine crenulato, fornice costâ, costâ valde arcuatâ, transversali, simplici.*

Hab. Eastern Seas. Mus. Cuming.

7. Puncturella princeps, Mighels and Adams.

Cemoria princeps, Mighels and Adams, Bost. Journ. Nat. Hist. vol. iv. p. 43.

The following descriptions of new *Naticæ* were communicated by Dr. Philippi:—

8. Descriptiones Naticarum quarundam novarum ex collectione Cumingiana, auctore R. A. Philippi.

1. Natica catenata, Phil. *N. testâ subglobosâ, tenui, lividâ, zonis quatuor albis, maculas fuscas semilunatas exhibentibus pictâ; anfractibus rotundatis; spirâ brevi usculâ, nigricante; sulcis radiantibus profundis superiorem anfractuum partem occupantibus; aperturâ semiorbiculari, intus purpureâ; umbilico amplo, margine acuto cincto; callo spirali satis valido medium umbilici occupante.*

Alt. $8\frac{1}{2}$, diam. $8\frac{2}{3}$ lin.

Hab. ——?

Differt a *N. tæniatâ*, Menke, anfractibus superius non horizontalibus sed declivibus, zonis longitudinaliter maculatis, callo labiali et callo umbilicali longe latioribus, etc.; a *N. depressâ* formâ globosâ, umbilico amplo, callo umbilicari mediano, etc.; a *N. maroccanâ* formâ globosâ, umbilico longe ampliore, callo ejus mediano, etc.

2. Natica Incei, Phil. *N. testâ depressâ, suborbiculari, solidâ, striatulâ, nitidâ, luteo-albidâ; anfractibus superius planatis; spirâ latè conicâ, acutâ; aperturâ semiorbiculari, valdè obliquâ; angulo basali columellæ incrassato; suturâ duplicatâ; callo maximo albo umbilicum magnum omninò implente.*

Alt. ab apice ad basin aperturæ $9\frac{1}{2}$, a dorso ad ventrem 6 lin.; diam. 12 lin.

Hab. ad insulam Raines, in freto Torres, ubi legit *Capt. Ince, R.N.*

Cave ne hanc speciem cum *N. Josephiniâ*, Risso (*N. Ollâ*, M. de Serr.), confundas, cui simillima est, et a quâ unice differt: ambitu paullo magis orbiculari; anfractibus minus rapide crescentibus; angulo umbilicum cingente paullo magis distincto; columellâ basi valde incrassatâ; callo umbilicari albo; colore fere albo in luteum vergente, præsertim versus basin, denique suturâ duplici. Linea superior suturæ a callo labiali, inferior a margine superiore anfractûs formatur, pariter ut in *Bulliis* d. Gray.—Operculum corneum.

3. Natica intemerata, Phil. *N. testâ globoso-ovatâ, solidâ, striatulâ, nitidâ, lacteâ, ad suturam versus umbilicum et in parte ultimâ anfractûs ultimi flavâ; anfractibus superius planiusculis; spirâ conicâ, circa $\frac{1}{3}$ altitudinis æquante; aperturâ semiorbiculari; columellâ rectâ, incrassatâ; umbilico magno, pervio, lacteo, sulco profundo lato exarato; funiculo semicylindrico ejus a callo labiali distincto.*

Alt. $18\frac{1}{2}$, diam. $17\frac{1}{2}$ lin.

Hab. in sinu Californiæ; legit *Rever. Steel.*

Simillima videtur *N. porcellaneæ* d'Orb., sed umbilico multo ampliore et colore flavescente differt; a *N. castâ*, Phil., testâ solidiore minus depressâ, umbilico albo angustiore, funiculo umbilicali longe magis elevato, etc. distinguitur; a *N. pede elephantis* testâ haud depressâ, funiculo umbilicali minus elevato satis superque discrepat.

4. Natica caribæa, Phil. *N. testâ ovatâ, sordidè albâ, ad suturam zonâ lacteâ munitâ; anfractibus superius vix convexis; spirâ brevi, acutâ; aperturâ semiorbiculari; umbilico parvo; callo lato cum labio confluente illum maximâ ex parte opplente.*
Alt. 8, diam. 7 lin.
Hab. in mari Caribæo ad insulam St. John.
Forma omnino accedit ad *N. mammillam* vel *N. lacteam* et umbilico pervio cum *N. lacteâ* convenit. Differt tamen umbilico longe angustiore, et callo ejus longe majore; an nihilominus mera varietas? *N. uberinâ*, d'Orb., testâ longe angustiore magis differre videtur.—Operculum tenue, corneum.

5. Natica vestalis, Phil. *N. testâ ovato-oblongâ, acutâ, lacteâ, substriatâ, nitidissimâ; spirâ acutâ, conicâ, sextam vel septimam totius altitudinis partem occupante; aperturâ semiorbiculari; callo convexo, crassissimo, cum callo labiali confluente, et sulco longitudinali ante marginem columellarem instructo, umbilicum fere omnino claudente.*
Long. 16½, diam. 16 lin.
Hab. ad oram Mozambique dictam; legit *Rev. Steel.*
Forte nihil nisi varietas *N. mammillæ*, a qua unice differt callo umbilicali crassiore convexiore, sulco longitudinali ante medium marginis columellaris, parte liberâ umbilicum cingente.
Obs.—Quæstio valde difficilis, utrum sub *N. mammillâ*, L. plures species lateant, an meræ varietates, vix examine singulorum speciminum in Musæis asservatorum decidi poterit, sed unice investigatione numerosæ gregis in ipso loco natali.

6. Natica? pomum, Phil. *N.? testâ ovatâ, inflatâ, tenuiusculâ, striatâ, glauco-fulvâ, basi albâ; anfractibus convexis, superioribus supernè subangulatis; spirâ quartam altitudinis partem æquante, subcontabulatâ; aperturâ ovato-oblongâ, propter anfractum penultimum prominentem fere lunatâ; umbilico angustissimo, perforato; labio parum calloso, basi supra umbilicum reflexo.*
Alt. 19, diam. 18½ lin.
Hab. ——?
Hæc species a reliquis Naticis valde aliena et forte ad genus *Amphibolam*, Schum. (*Ampullacera*, Quoy et Gaimard) mandanda est, etenim sinus latus satis profundus in parte supremâ labri hujus testæ in nullâ aliâ specie generis Naticæ observatur.

ROYAL SOCIETY.

June 16, 1853.—The Earl of Rosse, President, in the Chair.

"On the Anatomy and Physiology of *Cordylophora*, a contribution to our knowledge of the Tubularian Zoophytes." By George James Allman, M.D., M.R.I.A., Professor of Botany in the University of Dublin, &c.

The author, after pointing out the necessity of giving greater definiteness to the terminology employed in the description of the true zoophytes, proceeds to the anatomical details of *Cordylophora*, a genus of *Tubulariadæ*. He demonstrates that *Cordylophora* is essentially composed in all its parts of two distinct membranes enclosing a cavity, a structure which is common to all the *Hydroida*. For greater precision in description, he finds it necessary to give to these membranes special names, and he therefore employs for the external the name of *ectoderm*, and for the internal that of *endoderm*. Each of these membranes retains its primitive cellular structure. In the ectoderm *thread-cells* are produced in great abundance; these are formed in the interior of the ectodermal cells by a process of endogenous cell-formation, and are afterwards set free by the rupture of the mother-cell. The thread-cells in a quiescent state are minute ovoid capsules, but under the influence of irritation, an internal sac is protruded by a process of evagination; the surface of the evaginated sac is furnished with a circle of curved spicula, and from its free extremity a delicate and long filament is emitted. The thread-cells of *Cordylophora* thus closely resemble the "hastigerous organs" of *Hydra*. The polypary is a simple unorganized secretion deposited in layers from the ectoderm. In the endoderm, the author points out a distinct and well-developed glandular structure composed of true secreting cells, which are themselves produced in the interior of mother-cells, and elaborate a brown granular secretion which he assumes as representing the biliary secretion of the higher animals. He describes, as a system of special muscles, certain longitudinal fibres, which may be distinctly seen in close connection with the inner surface of the ectoderm. The tentacula are shown to be continuous tubes communicating with the cavity of the stomach, and thus possess the same essential structure as those of *Hydra*; they are formed of a direct continuation of the ectoderm of the polype, lined by a similar continuation of the endoderm. The appearance of transverse septa at regular intervals, which is so very striking in these tentacula, must not be attributed to the existence of true septa. It is due to a peculiar condition of the endodermal layer, but the author has not been able to give a satisfactory explanation of it. Through the whole of the canal which pervades the axis of the stems and branches, a constant though a regular rotatory movement is kept up in the contained fluid; this movement is not due to the propulsive action of vibratile cilia, and is explained by the author as the effect of the active processes going on in the secreting cells of the endoderm, processes which can scarcely be imagined to take place without causing *local* alterations in the

chemical constitution of the surrounding fluid, and a consequent disturbance in its stability.

The reproductive system of *Cordylophora* consists of ovoid capsules situated on the ultimate branches at some distance behind the polypes; some of these capsules contain *ova*, others *spermatozoa*; they are plainly homologous with the ovigerous sacs of the marine *Tubulariadæ*; they present a very evident, though disguised medusoid structure, having a hollow cylindrical body, whose cavity is continuous with that of the polype-stem, projecting into them below, and representing the proboscidiform stomach of a Medusa, while a system of branched tubes which communicate at their origin with the cavity of the hollow organ, must be viewed as the homologues of the radiating gastro-vascular canals, and the proper walls of the capsule will then represent the disc. From comparative observations made on other genera of *Hydroida*, the author maintains the presence of a true medusoid structure in the fixed ovigerous vesicles of all the genera he has examined, and he arrives at the generalization, that for the production of true ova in the hydroid zoophytes, a particular form of zooid is necessary, in which the ordinary polype-structure becomes modified, and presents, instead, a more or less obvious medusoid conformation, *Hydra* being at present the only genus which appears to offer an exception to this law, though the author believes that the exception is only apparent, and that further observations will enable us to refer the reproductive organization of this zoophyte to the same type with that of *Cordylophora* and the marine *Hydroidæ*. The author has satisfied himself that the ova-like bodies contained in the capsules of *Cordylophora* are true *ova*, and not *gemmæ*; he has demonstrated in them a distinct germinal vesicle, and has witnessed the phænomenon of yelk-cleavage; and the paper details the development of the embryo to the period of its escape from the capsule in the form of a free-swimming ciliated animacule, and traces its subsequent progress into the condition of the adult zoophyte.

MISCELLANEOUS.

On the Monstrosity of a Rose. By J. T. Arlidge, A.B.

With few exceptions the flowers on a standard-rose, growing on a lawn, failed this summer to exhibit good 'blooms,' and presented various degrees and forms of monstrosity. This occurrence may be attributed to the wet season stimulating the tree to the production of wood instead of flowers. It should, however, be noted, that neighbouring rose-trees, growing under precisely the same circumstances, but of different species, produced their proper flowers; with, however, a prevailing tendency to abortive petal-growth, and the production of the condition known as the 'green-eye.'

In the tree in question the most remarkable example was that of a

flower which was repeated three times on the same axis, each time exhibiting sepals, petals (coloured and scented), perfect stamens with pollen, and imperfect semi-leafy carpels. The stem expanded into its usual rounded receptacle, fringed by the free portion of the calyx of its general character, and supporting on its discoid margin the petals, and within these numerous stamens. Some of the innermost petals were not well-coloured, nor well-developed, but small and greenish.

From the sides of the cup-like receptacle sprang several hairy styles crowned by their stigmas, of much the usual form, but still not well-formed; and along with these imperfect carpels of a green colour, and having the form of narrow leaves folded longitudinally on themselves, and many of them terminating in a fringed process or awn. Neither the normal styles nor the leafy carpels had ovules. The centre of the cup exhibited a larger carpellary leaf so folded as to enclose one or more similar though more delicate leaves and a growing point, representing a continuation of the stem. This point gradually elongated, developed towards one side two lanceolate decurrent leaves or bracts, which, like itself, assumed a reddish colour. Having acquired about an inch in length, it shot out five ovate-lanceolate, acuminate sepals, confluent at their base and decurrent, not on the same plane but spirally arranged, and also tinged red. Thus a second flower grew in all respects like the first, except that it had a very indistinct receptacle. During the development of the second, the first flower withered, its petals falling away. The axis of the second inflorescence, endued with the like powers of growth, extended itself, produced a sheathing bract, then swelled into a half-globular receptacle, with five sepals as in the last, but here set in a regular whorl on the same plane, and having two bracts, like themselves, immediately external to them.

The petals of this third flower were numerous, small indeed, but sweet-scented: the stamens numerous, containing pollen; whilst a few very rudimentary, slender, carpellary leaves and styles surrounded a larger involuted one containing a growing point along with two or three pistils terminated by stigmas.

In this terminal inflorescence (examined whilst actually flowering) the carpellary leaves were smallest, and the leaf-like character most lost; whilst many styles, hairy and delicate, occupied the concavity of the receptacle, and apparently had perfect carpels at their base.

The production of these three flowers in sequence occupied two months.

On a longitudinal section the growing point in each flower was seen not to have proceeded from the exact centre or actual axis of the receptacle, but rather from one side. Hence both the irregular peduncles curved so as to maintain the flower in the same line with the original stem.

In another monstrosity, in which two flowers were produced on the same continuous axis, the sepals exhibited a tendency to be compound by developing imperfect leaflets.

In a third example the sepals had grown into large compound leaves, having two leaflets on each side the petiole, and a very large

terminal one. In this case too, where but one flower formed, the growing point started at nearly a right angle to the original peduncle, and then, curving to bring itself in the same straight line, grew into a strong shoot, forming at its apex a good bud (flower) for the winter.

A similar growth of the calyx into actual leaves occurred in another case.

The last irregularity to which I shall refer is, where the axis of a flower grew into a strong leafy shoot. In this case no cup-like receptacle existed, but the carpels were placed on a disk-like expansion surrounding the stem, which appeared little more than a large node from which the leaves had fallen. The carpels here extended upwards in a green, leafy form, and were deficient of ovules. Eight such, with dilated, capsule-like bases, were found in a whorl on the same plane; and within these, two close together, longer and of a more leaf-like character. Above these last, five more evident leaves, four of which were actually trifoliate, were disposed in a spiral manner around the axis for the space of an inch above the carpellary whorl. Then a node occurred, surrounded by six pinnate leaves, not quite on the same plane, and yet not in opposite pairs, nor clearly spiral in position. Three-quarters of an inch from these leaves the shoot ended by a terminal bud (winter) surrounded by three pinnate leaves of unequal size.

These instances of monstrosity well illustrate the morphology of carpels—their origin from leaves, and their tendency to take on the form, and along with this, the spiral arrangement of the latter. The perfect pinnate leaves of a shoot proceeding from the centre of a rose we must suppose to be morphologically the same with the small folded carpellary leaf; the last instance cited shows the grades of development between the two.

The production of the shoot causes the abortion of the flower and its ovules; hence the size and vigour of the shoot afford a measure of the vital vegetative force expended in the formation of a flower, and mainly of its ovules.

I am inclined to believe with Schleiden, that the ovule is a product of the axis and not of the carpellary leaves; that indeed it is a bud growing from the axis in the axil of a leaf—*i. e.* the carpel.

On the Change of Colour in a Chamæleon (Chamæleo vulgaris).

By H. N. Turner, Jun.

Notwithstanding that the peculiarity of the Chamæleon in changing its colour is so universally known, and that an illustrated work on the subject was published by Van de Höven, I have thought that a careful record of the varieties of tint, presented by the specimen which has lived for some time in my possession, might prove serviceable to the naturalist if compared with similar observations upon other species and upon the same one under different circumstances, and might also assist in the determination of the means by which it is effected, the influences by which it is regulated, and the objects which it serves in the œconomy of the animal.

Its general tints vary between different shades of brown, olive, yellow, and light green, the last-named being the most rarely observed, and the yellow being the tint usually assumed when the animal has been hidden from the light. This is the colour it always presents if taken for inspection at night, and when brought into the influence of lamp-light it appears at first almost white, but may soon be seen to darken and some of the markings to appear. The side that is next the light will change rather sooner than the other, the changes being always gradual. It has three distinct sets of markings, the first to appear being two ranges of irregular distant elongated spots, which may appear either as a dark tint upon the ground-colour when that is light, or a light one if it be dark. These marks are never entirely absent when either of the other sets is present, although sometimes but faintly discernible.

The other two sets of markings consist of an irregular marbling, and a number of full round spots; the latter never appear otherwise than as dark upon the ground-colour, and the marbling, which is generally also dark, only occasionally appears a little lighter than the ground-colour, and then of a different tone; either may be visible without the other, or both may be distinctly traceable. Sometimes the marbling will be apparent together with such of the spots as are placed within its intervals, those upon the surface occupied by the marbling being amalgamated with it.

When the general colour is light yellow or pale greenish, which is the case if the animal be suddenly brought into the light, the elongated spots, which form two rows on each side, will begin to appear of a very delicate purple tint. After that the marbling gradually shows itself, and the general tint begins to darken; when some time has elapsed a brown colour is assumed, and the elongate spots, at first purple of a darker tint than the yellow ground-work, are seen to be brown, of a lighter and rather richer tint than that which now pervades the whole. These distinctions may go on increasing, may then decrease and again increase; the spots may appear, may come and go with different degrees of intensity, so that the variety of appearances presented is almost indefinite. When visited in the day-time, the colour is generally brown, sometimes without markings, generally with the elongate spots of a lighter tint, and the marbling or the round spots, or both, more or less apparent. Occasionally it presents a uniform dull olive, and then has no markings. Sometimes it is of a light drab colour, with the different marks faintly indicated. The ventral series of prominent scales remains constantly white, as stated by Van der Höven, not participating in the changes of the surrounding parts.

This author does not in any of his plates represent the longitudinal rows of markings as a decided dark upon the ground-colour, nor is the marbling anywhere clearly shown as pervading the whole body; neither does he give the deep brown tint with the marbling as a dark, and the longitudinal rows of spots definitively marked as a light.

I have never seen my specimen present anything like the appearances delineated in his plates 4 and 5, probably because I have not irritated it.

It has generally been imagined that the purpose of this singular faculty accorded to the Chamæleon is to enable it to accommodate its appearance to that of surrounding objects, but the observations of Van der Höven seem to negative that idea, and the few experiments I have made with that view have not led to any such results. The box in which it is kept is of deal, with a glass at the top and a piece of flannel laid at the bottom; a small branching stick being introduced by way of a perch. I have introduced at various times pieces of coloured paper, covering the bottom of the box, of blue, yellow and scarlet, but without the slightest effect upon the appearance of the animal. Considering that these primary colours were not such as it would be likely to be placed in contact with in a state of nature, I next tried a piece of green calico, but equally without result. The animal went through all its usual changes, without their being in any way modified by the colours placed underneath it. The general tints approximate, as may readily be observed, to those of the branches of trees, just as those of most animals do to the places in which they dwell; but I have never seen the faculty of changing called into play with any apparent object. It is only when the light is removed that the animal assumes a colour which absorbs but little of it.

Regretting that I have not been able to attain any more definite conclusions, I offer these few remarks, hoping that to some naturalist, who may undertake the investigation of these singular phænomena, they may prove not to have been thrown away.—*Proc. Zool. Soc.* July 22, 1851.

Notes on a new species of Artamus, *from India.*
By Dr. Nicholson.

These birds are only found in very thick jungles among the brushwood, where they are always moving about, and are shot with great difficulty, and even then, if not killed outright, they are so tenacious of life, that they creep into the first hole or crevice they come to. The only note I ever heard was like 'chick, chick.' I think they are residents, but the few I have seen just appear and are lost again in a moment, so that I know little of their habits; the one described here had one leg and both wings broken, and still crept into the hole of a jerboa-rat, from which I dug it out dead.

Male: weight $6\frac{1}{2}$ oz.

Length from bill to tip of tail $7\frac{2}{8}$ inches. Alar extent 10 inches.

Head large. Bill strong, narrow and sharp, gently arched on the culmen; a distinct notch near the tip of upper mandible; gape wide. Tongue horny and divided at the point. Nostrils basal, small. Eye rather small. Iris of a silvery colour, tinged with yellow.

Wings rounded; first quill very short; third longest; second, third and fourth quills emarginate on outer web.

Tail short, and nearly even at the end, of twelve feathers, $2\frac{3}{4}$ inches long.

Tarsus strong. Hallux and claw stronger than the other toes, and

as long as the inner toe, and has a large pad at its base; the outer toe is shortest; the claws are much hooked.

Contents of stomach were a few grains of *Holcus spicatus* and the exuviæ of insects.

Plumage is soft and loose.

Colours: the whole top of the head is covered with a cap of black. Bill lead-colour at base and black at the point. The chin, the breast, and all underneath white; the body all above of a leaden colour. Quills and tail of a light black, edged with light on both webs; the outer web of the outer tail-feather is white, as well as the tips of the first five on each side. Feet and legs black.

I propose for this species the name of *Artamus cucullatus*.—*Proc. Zool. Soc.* June 10, 1851.

METEOROLOGICAL OBSERVATIONS FOR AUG. 1853.

Chiswick.—August 1. Uniformly overcast: very fine: rain at night. 2. Very fine. 3. Uniform haze: clear. 4—8. Very fine. 9. Slight haze: very fine: clear. 10. Very fine. 11. Slight fog. 12. Cloudy and fine. 13. Overcast. 14. Cloudy. 15. Cloudy and fine. 16. Uniformly overcast: rain. 17. Very fine. 18. Slight fog: very fine: clear. 19. Foggy: very fine: slight rain. 20. Slight rain: cloudy and fine. 21. Very fine. 22. Fine: cloudy: heavy rain at night. 23. Rain: cloudy: clear. 24. Dense fog: dusky haze: fine. 25. Overcast: slight showers: boisterous, with rain at night. 26. Very boisterous throughout. In this and the preceding day a large quantity of air from the south must have moved over the kingdom. 27. Cloudy and rather boisterous. 28. Clear and very fine. 29. Overcast: very fine. 30, 31. Very fine.

Mean temperature of the month	59°·69
Mean temperature of Aug. 1852	63 ·67
Mean temperature of Aug. for the last twenty-seven years	62 ·12
Average amount of rain in Aug.	2·35 inches.

Boston.—Aug. 1. Cloudy: rain A.M. and P.M. 2. Fine. 3. Cloudy. 4. Fine. 5—8. Cloudy. 9—11. Fine. 12—15. Cloudy. 16. Cloudy: rain A.M. 17. Cloudy: rain P.M. 18. Fine. 19. Cloudy. 20. Cloudy: rain A.M. 21, 22. Fine. 23. Cloudy: rain A.M. 24. Fine: rain P.M. 25. Cloudy: rain A.M. 26. Rain A.M. and P.M. 27. Cloudy: rain A.M. 28, 29. Cloudy. 30, 31. Fine.

Sandwick Manse, Orkney.—Aug. 1. Drizzle A.M.: rain, fair P.M. 2. Cloudy A.M.: damp P.M. 3. Showers A.M.: fair P.M. 4. Cloudy A.M.: showers P.M. 5. Cloudy A.M.: drizzle P.M. 6. Drizzle A.M. and P.M. 7, 8. Cloudy A.M. and P.M. 9. Bright A.M.: clear P.M. 10. Clear A.M.: clear, fine P.M. 11. Bright A.M.: cloudy P.M. 12. Cloudy A.M.: fine P.M. 13, 14. Cloudy A.M. and P.M. 15. Damp A.M.: cloudy P.M. 16. Cloudy A.M.: clear, fine P.M. 17. Showers A.M.: clear, fine P.M. 18. Clear A.M.: clear, fine P.M. 19. Damp A.M.: thunder and lightning, showers P.M. 20. Bright A.M.: thunder and lightning, showers P.M. 21. Bright A.M.: clear P.M. 22. Bright A.M.: showers P.M. 23. Cloudy A.M.: showers P.M. 24. Bright A.M.: clear, aurora P.M. 25. Clear, fine A.M.: drizzle P.M. 26. Rain A.M.: cloudy P.M. 27. Rain A.M: damp P.M. 28. Damp A.M.: drizzle P.M. 29. Damp A.M.: cloudy P.M. 30. Cloudy A.M. and P.M. 31. Bright A.M.: drizzle P.M.

Mean temperature of Aug. for twenty-six previous years	55°·08
Mean temperature of this month	55 ·98
Mean temperature of Aug. 1852	60 ·64
Average quantity of rain in Aug. for seven previous years	2·70 inches.

On the 24th, from 9½ till 10 P.M., a comet was seen with a long bright tail, about 5° above the horizon in the N.W. The nucleus like a star of the first magnitude.

Meteorological Observations made by Mr. Thompson *at the Garden of the Horticultural Society at* Chiswick, *near London*; *by* Mr. Veall, *at* Boston; *and by the* Rev. C. Clouston, *at Sandwick Manse*, Orkney.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston.	Orkney, Sandwick.		Chiswick.		Boston.	Orkney, Sandwick.		Chiswick.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1853. Aug.	Max.	Min.	8¾ a.m.	9¼ a.m.	8½ p.m.	Max.	Min.	8¾ a.m.	9¼ a.m.	8½ p.m.	1 p.m.					
1.	29·932	29·801	29·37	29·65	29·71	76	58	67	57	53	sw.	wsw.	w.	·03	·04	.....
2.	29·929	29·866	29·40	29·80	29·93	73	52	61	58	54	ne.	n.	w.	.....	·06	·20
3.	29·982	29·919	29·54	29·87	29·83	74	52	61·5	53	53	e.	nnw.	w.	.....	.....	·12
4.	30·025	30·005	29·58	29·92	30·04	74	45	57·5	58½	54	ne.	nnw.	wnw.	.....	.....	·02
5.	30·122	30·115	29·65	30·09	30·12	71	45	64	59	56	ne.	nw.	w.	.....	.....	·02
6.	30·226	30·160	29·74	30·08	30·06	74	48	58·5	56	54	sw.	nw.	w.	.....	.....	·03
7.	30·203	30·130	29·70	30·14	30·17	70	50	59	57	56	ne.	n.	sw.	.....	.....	·01
8.	30·192	30·151	29·72	30·11	30·08	75	47	68	60	59	ne.	calm	s.	.....	.....	.....
9.	30·260	30·230	29·75	30·11	30·26	72	43	70	59	55	ne.	s.	w.	.....	.....	·07
10.	30·322	30·247	29·85	30·32	30·34	72	47	66·5	58	55	ne.	s.	s.	.....	.....	.....
11.	30·288	30·145	29·79	30·31	30·31	75	46	66	58	56	se.	nnw.	w.	.....	.....	.....
☽ 12.	30·195	30·117	29·74	30·31	30·31	68	54	61	59	56	ne.	n.	w.	.....	.....	.....
13.	30·143	30·047	29·65	30·28	30·23	67	52	63	56	54	ne.	n.	n.	.....	.....	.....
14.	30·015	29·959	29·60	30·16	30·12	64	51	60	58	54	e.	n.	n.	.....	.....	.....
15.	29·994	29·929	29·52	30·02	29·92	65	46	62	56½	53½	n.	nnw.	nw.	.....	.....	.....
16.	29·780	29·194	29·36	29·84	29·80	65	54	66	56	50	e.	sse.	ne.	·36	.....	·08
17.	29·704	29·507	29·05	29·78	29·83	71	41	57	54½	50½	w.	ne.	nw.	.....	1·00	·03
○ 18.	29·904	29·870	29·46	29·84	29·82	73	51	59	61	52½	s.	calm	se.	.....	·14	.....
19.	29·874	29·822	29·43	29·68	29·68	77	61	65·5	61½	57	sw.	calm	e.	·02	.....	·15
20.	29·864	29·811	29·30	29·63	29·60	76	51	68	61	57	sw.	w.	e.	·01	·02	·30
21.	29·977	29·925	29·44	29·54	29·68	73	55	63	61½	57	w.	w.	sw.	.....	.....	·12
22.	29·868	29·811	29·40	29·63	29·67	74	54	63	59½	54	e.	nw.	w.	·67	.....	.....
23.	29·765	29·733	29·30	29·68	29·64	63	45	60·5	57	53½	e.	nw.	w.	·01	·18	·06
24.	29·800	29·694	29·38	29·65	29·72	66	44	60	56	53	e.	calm	w.	.....	.....	·70
25.	29·730	29·436	29·26	29·72	29·68	66	54	63	60	53	s.	s.	e.	·23	·14	.....
☾ 26.	29·268	29·116	28·80	29·37	29·21	66	51	63	56½	57	s.	ssw.	e.	·49	·18	·46
27.	29·502	29·305	28·76	29·17	29·23	63	47	62	56½	55½	sw.	ssw.	nne.	·01	·52	·37
28.	29·748	29·624	29·10	29·34	29·54	66	45	58	57½	54	sw.	w.	nnw.	·02	.....	·04
29.	29·849	29·803	29·33	29·69	29·77	67	43	61	56	54	sw.	sw.	calm	.....	.....	·04
30.	29·972	29·896	29·50	29·80	29·80	68	47	58	55½	51	sw.	sw.	ne.	.....	.....	·01
31.	29·881	29·846	29·38	29·74	29·81	67	51	57	56	51	sw.	sw.	ne.	·02	.....	.....
Mean.	29·945	29·858	29·44	29·847	29·868	70·03	49·35	62·0	57·70	54·27				1·87	2·28	2·83

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

No. 71. NOVEMBER 1853.

XXVIII.—*On the "Nucleus" of the* Characeæ. By Al. Braun*.

[From his Memoirs on the Circulation in the Characeæ.]

In the cells immediately serving for the reproduction of the Characeæ, the germ-cell or spore and the mother-cells of the spermatozoids, there is no circulation of the sap, but a circulation is met with in various cells of the enveloping organs, through the medium and under the protection of which the essential reproductive cells are produced. I cannot avoid discussing a few general points connected with these most peculiarly formed organs of the Characeæ, the import of which has been explained in the most varied ways. The organs in question are of two kinds. The *one*, the seat of formation of the spermatozoids, usually named, in avoidance of any functional signification, simply the *globule*, formerly regarded as an anther, and even as a pollen-grain †, or erroneously asserted to be a bud capable of germination ‡, is now generally termed the *antheridium*. Aberrant as its structure is from all other known antheridia, it appears to me, from its centripetal development, to possess a certain agreement with the antheridia of the Mosses and Liverworts, so that I cannot, with Hofmeister (Flora, 1851, No. 1), term it a convolute of many antheridia or a 'head' of antheridia. In the antheridium are formed the active seminal filaments (*spermatozoa, antherozoidia*), which were first seen by

* Monatsber. K. Preuss. Acad. Jan. 1853. Translated by Arthur Henfrey, F.R.S. &c.

† Meyen, Linnæa, 1827, p. 63.

‡ Wallroth, Ann. Bot. 1815, p. 170. Reichenbach (Flor. Germ. exc. p. 147), on the contrary, regards the female organ as a bud, and the globule as an androgynous flower with eight pistils and numerous staminodia.

Bischoff in the year 1828*, who at that time regarded them as Infusoria. Varley (1834) first saw their exit from the cells of the antheridial filaments; but the two most delicate cilia, by the vibration of which the spirally wound body is set in motion, were first described by Thuret in the year 1840†. Thuret saw these cilia in *Nitella syncarpa* and *Chara fragilis*; I have seen them so distinctly in *Chara aspera* and *ceratophylla*, that no doubt whatever can exist as to their presence. I have only to add to Thuret's account, that I have found the winding of the spiral body constant to the *right* in *Ch. fragilis*. The *second* organ of fructification, in which the spore is developed, regarded by the older botanists as a pistil, and in the ripe condition called either capsule (Vaillant), berry (Sprengel, Willdenow), drupe (Bertoloni), or nucule (Wallroth), or merely seed (Linnæus), has been subsequently, quite as unfitly, termed a spore-case, *sporocarp* (Bischoff), or *sporangium* (Cosson and Germain). Hofmeister compares it with the *archegonium* (*pistillidium*). Apt as this comparison seems in reference to the reduction of the characters of fructification of all the higher (spermatozoid-bearing) Cryptogamia under one common point of view, since in this way all the plants with unequivocal antheridia likewise possess an archegonium, peculiar difficulties are met with in the attempt to carry out the parallel. That which has been called an archegonium, is an organ of the first generation of the leafy Cryptogamia, the generation growing up from the spore, in which organ, according to the researches so profoundly followed out by Hofmeister in particular, the germ-cell of the second generation is produced by free cell-formation, and developed after impregnation (like the embryo of the Phanerogamia). In the Vascular Cryptogamia (Ferns, *Equiseta*, &c.) the first generation consists of a leafless, thalloid preparatory structure, the pro-embryo or *prothallium*, while the second generation is developed into the leaf-producing 'stock,' the vegetative, and finally spore-bearing plant; in the Mosses, on the other hand, the first generation advances from the thalloid preparatory structure to the leaf-producing 'stock,' while the second generation is represented by a peculiar fruit-structure serving merely for the production of the spores, and this structure, emerging from the cavity of the archegonium, sometimes breaks through the cover (*calyptra*) formed by the latter, and sometimes carries it up through its becoming detached below. In the lowest groups of Hepaticæ, especially in the *Ricciæ*, this fruit-structure, so complicated in the higher Mosses,

* Crypt. Gewächse, p. 13. in the note.

† Ann. des Sc. Nat. 2nd sér. xiv. (1840), p. 65; and 3rd sér. xvi. (1851), t. 9.

is of extremely simple nature, and remains enclosed at the bottom of the archegonium, without freeing itself from its coats. "From the Mosses with the simplest structure of the fruit, finally," continues Hofmeister*, in his description, "it is only one step to the Characeæ, in which the influence of the spermatozoid on the central cell of the archegonium does not lead to the production even of the simplest kind of cellular mass, but merely to the filling up of the reproductive cell found free in that central cell, with starch and oil. The *Charæ*, in which the prothallium is the entire plant, thus represent one end of the series, the other end being formed by the Phanerogamia (exclusive of the Coniferæ), in which the whole plant corresponds solely to the second spore-producing generation of the Vascular Cryptogamia, and the cell-formation in the embryo-sac previous to the impregnation scarcely even reminds us of the multifold vital phænomena of the prothallia of the Ferns and of the albumen mass of the Coniferæ."

For the further elucidation of the relations in which the Characeæ stand to the rest of the Cryptogamia possessed of antheridia and archegonia, we must in the first place accurately examine whether they really have these two distinct generations, even with ever so slight a development of the second, to which the transition from the first is caused by impregnation, or whether they complete their entire cycle of life in one generation (leaving ramification-generations out of view). According to Hofmeister's description, there is found in the central cell of the archegonium of the Characeæ, a new cell, the development of which into the spore containing oil and starch is dependent on impregnation. If this be the condition, if that which is found in the central cell is a mere spore, there is in fact no alternation of generations, but only one generation, for the spore in this case is the primary cell of a generation which essentially resembles that by which it is produced. If we compare, then, the one generation of the Characeæ with the *first* of the higher Cryptogamia, especially with the prothallium of the Vascular Cryptogamia, Hofmeister's interpretation appears warranted on one side, in so far, namely, that the structure of the Characeæ termed an archegonium is a female organ (receiving impregnation), borne by the prothallium, but, on the other hand, unsupported, since this does not produce any second, spore-bearing generation, but merely a spore. But if the comparison with the archegonium is nevertheless to be maintained, we must extend it to organs through which the spore-formation is brought about in the lower (leafless) Cryptogamia, an extension for which many

* Flora, 1851, No. 1. p. 7.

grounds may indeed be found, but would lead far away from the strict definition of the archegonium, as hitherto held. The supposed asexuality of the lower Cryptogamia could not restrain the indicated extension of the conception of the archegonium to the sporangial structures of the lower Cryptogamia, since a duplicity of sexes is constantly being demonstrated as more widely extended among the lower Cryptogamia*, and the term antheridium has also been frequently applied in analogous extension already (for instance to the organs of the Fucoideæ, Floridеæ, Lichens and Fungi). The question is, therefore, whether the morphological agreement of the female organ of fructification of the Characeæ with that of the Mosses, Ferns, Equiseta, Lycopodiaceæ and Rhizocarpeæ, is of a kind to render the use of the same name for both suitable.

It cannot be denied that it at first sight appears to have a similar structure. The envelope—composed of five rows of cells terminating in the form of a five-pointed coronet, at a particular period open—surrounding the central cell of the female organ of fructification in the Characeæ, reminds us very much of the more or less elongated style-like structure composed of a determinate number of rows of cells, surrounding and surpassing the central cell of the archegonia, especially when, as in *Pilularia* and *Equisetum*†, the uppermost cells of these diverge like rays in the same manner as the coronets of many species of *Chara*. But when we turn back to the earlier stages of development, we find that this resemblance is deceptive. The *archegonium* is in all cases an originally *closed*, more or less elevated, cellular cover, under which the central cell is concealed from the beginning. The tubular canal leading to the central cell is formed subsequently by the separation of the cells from each other. The reverse takes place in the Characeæ; here the central cell is originally uncovered and gradually becomes overgrown and enclosed by the cells of the envelope. Therefore the envelope and coronet of the Characeæ are altogether different, morphologically, from the envelope and tube which surround the central cell in true archegonia, and this takes away all ground for close comparison; I shall not trace the more distant analogies which may exist between the archegonia of the higher Cryptogamia and the organs of fructification of the rest of the Cryptogamia. A different ex-

* See among others, Thuret, Recherch. sur les Antheridies des Cryptog. (Ann. des Sc. Nat. 3rd sér. xvi.); and Tulasne, Mém. p. servir à l'Hist. des Lichens (Ann. des Sc. Nat. 3rd sér. xvii.).

† See Hofmeister, Vergleich. Unters. der höh. Cryptogamen, t. 21. (*Pilularia*); Milde, Flora, 1852, No. 32. t. 7; and Hofmeister, Beiträge zur Kenntniss der Gefässcrypt. t. 17 & 18 (*Equisetum*).

planation from Hofmeister's was proposed by Griffith*, and still earlier, but less consequently, by Meyen†. Both compared the fruit of the Characeæ to the *ovules* of the Phanerogamia, regarding the envelope as integument, the central portion as nucleus. Since the single generation of the Characeæ, as the producer of spores, may be compared with the *second* generation of the Vascular Cryptogamia, a comparison still further supported by the fact that the entire mode of construction of the Characeæ by no means belongs to the forms of thalloid structure, but exhibits a definite contrast of stem- and leaf-formation, nothing can be said *à priori* against seeking a comparison on this side. In the gradual closing together of the central body, the envelope of the *Chara* fruit certainly exhibits a similar behaviour to the integument of the Phanerogamic ovule, and the comparison of the central portion with the nucleus seems even still more apt. This central portion, hitherto regarded as a single cell, is in fact a cellular body formed of four cells, one of which by preponderating growth at an early period displaces the rest, and may be compared with the embryo-sac. It might appear as though nothing were wanting in this comparison but the formation of an embryo in the large cell of the central body. But after close examination, only a distant resemblance remains even on this side; for while the integument of the Phanerogamic seed corresponds to a closed sheath-like leaf, the integument in *Chara*, as I shall demonstrate hereafter, is an envelope formed of a five-leaved whorl. The greatest difference however relates to the nature of the large cell of the central portion, which, for comparison either with the embryo-sac or with the central cell of the archegonium, must be the mother-cell of a germ-cell, the origin of which, according to Hofmeister's account in the above-named places, actually takes place by free cell-formation.

Fully as I trust in the acuteness and accuracy of Hofmeister's observations, and desirable as the confirmation of his statements would be to me, I have not yet succeeded in convincing myself of their correctness; I have seen a nucleus, and in later stages a vacuole in that cell, but could never detect the formation of a real daughter-cell in it; on the contrary, the entire large cell in every case appeared to become developed into the spore. If this be really the case, it offers the *weightiest* objection against too close comparison both with the ovules of the Phanerogamia and with the archegonium of the Cryptogamia, since a spore-formation of such a kind would rather point to a comparison with the lower groups of the Cryptogamia, in which alone occurs spore-

* Calcutta Journ. of Nat. Hist. vol. v. (1844), p. 241.

† Pflanzenphysiologie, iii. (1839), p. 354.

formation of spores by mere detachment of cells, or tying-off (*abschnürung*) as it is termed. Therefore to avoid using any name referring to too distant analogies, I shall apply to the female organ of fructification with its accessory portions, as a whole, for reasons to be explained hereafter, the name of spore-bud (*sporophysa*), distinguishing the envelope surrounding the spore as the spore-coat (*sporostegium*).

Thus, through the spore-formation, through the want of the alternation of generations proper to the higher Cryptogamia, as also through the true cellular structure, the Characeæ will adjoin the lower Cryptogamia; while on the other hand, the presence of convoluted spermatozoids, as also the contrast of stem- and leaf-formation, connect them with the higher Cryptogamia, so that they occupy a strange intermediate position between the two. That they possess a real (active) contrast of sexes is indicated, in the first place, by the spermatozoids, the necessity of which for impregnation has been demonstrated by numerous observations and experiments in the higher Cryptogamia*; so that, looking at the great resemblance those of the Characeæ possess to those of the higher Cryptogamia, especially those of the Mosses and Liverworts, we can certainly apply the Aristotelian *οὐδὲν γὰρ μάτην ἡ φύσις ποιεῖ*. It is further testified by the distribution of the sexes, analogous to that of the higher plants, sometimes both to one plant (monœcious), sometimes in distinct plants (diœcious), in which latter case 'stocks' of both kinds are usually found in company†.

The order of development of the organs of fructification also agrees, since in general the development of the antheridia precedes that of the spores, which is especially striking in those species where life is of short duration, as, for instance, *Nitella syncarpa* and *fasciculata*. The frequent occurrence of a peculiar mode of degeneration of the spore-coat, probably connected with sterility of the spore, wherein the hard shell, which in the normal condition protects the spore, is not formed, seems likewise to indicate the necessity of impregnation, yet it is remarkable that the spore itself, in such degenerated spore-coat, is as abundantly filled with starch as the normal.

* The recent experiments of Hofmeister with *Selaginella* (Vergleich. Unters. p. 124) and *Isoëtes* (Beiträge z. Kenntniss der Gefässcrypt. p. 128), bring new confirmation of the older ones of Savi on *Salvinia* and Fabre on *Marsilia*.

† *Ch. stelligera*, Bauer, forms an exception to this, only specimens bearing antheridia having been hitherto found in its known stations in temperate and northern Europe. The Italian *Ch. ulvoides*, described by Bertoloni, appears to be the female plant of a more vigorous form of the same species. *Ch. stelligera* is a plant which is abundantly and readily increased also in the vegetative way by its stellate, sprouting tubercles.

XXIX.—*On the Branchial Currents in the Bivalves.*

By William Clark, Esq.

To the Editors of the Annals of Natural History.

Gentlemen, Exmouth, September 1853.

I request permission to reply to Messrs. Alder and Hancock's comments in the 'Annals of Natural History,' vol. viii. p. 370. Pl. XV. N. S., on my branchial theory, which appeared in a paper on the *Pholadidæ* in vol. vi. p. 313 of that publication. I was so engaged last year in the examination of a splendid harvest of rare animals, that I had no time to consider their remarks, but having now an unlimited supply of *Pholades*, I will endeavour to acquit myself of my engagements with these gentlemen.

They commence by quoting parts of my theory, and say that I announce "that $\frac{9}{10}$ths, if not all, the branchial water is admitted by the pedal gape." On this point they observe—

"Let us for a moment consider what would be the consequence of Mr. Clark's supposition, that these animals obtain water only by the pedal gape. Nearly all of them pass their lives buried in sand or mud, or immured in solid stone, with only a small aperture externally, the pedal opening being beneath, and the siphonal tubes in communication with the sea. Yet Mr. Clark would have these animals receive only the small quantity of water charged with sand and mud that finds its way to the bottom of the cavity, rather than draw their supply from the pure element on the surface, by means of their long siphons."

To this quotation I reply, that a fresh and very extended examination of four species of the *Pholades* fully supports me in maintaining all my positions, and I think I shall demonstrate that Messrs. Alder and Hancock's system of branchial currents is erroneous. The only correction I have to make is, that I have clearly ascertained that the branchial, like the anal siphon, is both inhalant and exhalant.

With respect to their observations on the habits of the *Pholades*, it is only necessary to admit, that these animals often inhabit sand and shingle, mixed with clay, and are not always imbedded in hard rock. But we contend that the cavities in which they dwell afford sufficient passage for the sea water, and the areas of their habitats are saturated therewith, as when the tide withdraws, much of its waters is retained by the various strata, which by filtration reaches the burrows in a pure state, and not "charged with sand and mud."

Continual watchings for months of multitudes of these ani-

mals prove beyond doubt that the water is not only copiously received at the pedal gape or aperture, but is often expelled with as much force, and with a similar formed jet, as from the branchial siphon; and my dredger, who during the last fifty years has excavated more *Pholades* than any man in existence, says, that he continually sees the water expelled from the pedal gape. This is an important fact in corroboration of my theory, as an in- and ex-current is established pedally in combination with the branchial siphon.

I will now mention a decisive proof that nature, in all the bivalves, intends the water, under certain conditions, to be received and expelled by the pedal gape or aperture. When the gape of the *Pholas papyracea* is closed, by being domed by the animal, a large ovally dilatable fissure is always left for the water in the connecting membrane of the laminæ of the dome, in its centre, to correspond with the gape that has been rendered ineffective. And in the linear Solens, in which, from the quality of the foot and its singular position, the water cannot well enter pedally, a similar aperture is also left in the membrane of the connecting valves. In the *Myæ* and other bivalves the water can get access through the ventral and pedal apertures. Thus we learn from these examples that when nature has denied the ordinary pedal entry and exit for the fluid, she always supplies a compensation.

The periodic entry and reflux of the branchial water present two distinct characters; the one being regular, the other more uncertain. With respect to the first, place a dozen *Pholades* and as many *Pullastra pullastra*, or *P. decussata*, in a dish of sea water: it will be seen that each has a regular periodic action, the *Veneres* usually from one to two minutes, and the *Pholades* three to four, until a change of circumstances induces a new disposition. The entry and issue of the fluid, in conjunction with the pedal gape and aperture, are thus performed:—the animal simultaneously closes the orifices of both siphons, which after a short pause are again opened; the effete water flows from both, and fresh is received. But independent of these silent though very visible operations, there is about every five minutes a powerful and copious jet from both tubes, sometimes simultaneously, at others at intervals, and that from the branchial tube in the *Pholades* is almost always accompanied by a strong ejection from the pedal gape, and also in the *Veneres* from the pedal aperture, though from the absence of a gape in their shells it is not so visible. The periodic times of the in- and out-flux, of whichever character it may be, as the animal becomes exhausted, are more and more prolonged; they are only in vigour for twelve hours.

What is the object of these copious and regular receptions

and expulsions of water? Will not every reasonable person acknowledge that they can only serve for branchial purposes—the receptions, to administer water to the gill-laminæ, and the expulsions to remove it when effete by the contraction of the adductors of the valves and siphonal retractors? In corroboration of the above, I particularly refer to the Rev. James Bulwer's account of the *Isocardia cor*, published in the 'Zoological Journal,' vol. ii. p. 258. Messrs. Alder and Hancock cannot controvert these facts, and therefore in relation to my theory say, "This is, however, a special case having nothing to do with the regular branchial currents, as has before been pointed out to Mr. Clark."

My opponents may find their special case a general law, and their system of regular branchial currents an illusion.

They, having discovered that no ascertained communication—[this is a condition of my theory]—existed between the branchial and anal chambers, thus express the fact:—"We certainly find no opening between the foot and the gills, nor between the gills and the mantle;" and in consequence of their favourite doctrine being in jeopardy, they "found it necessary to make a careful examination of the anatomical structure of these animals," and have informed us of the discovery of a channel, by declaring the gill-laminæ and their interbranchial tubes permeable, on which—to them a most important fact, if true—they emphatically observe, "Thus in an instant the secret was explained; the currents communicate through minute openings in the laminæ of the gill-plates."

I think these gentlemen have formed an erroneous conclusion: I cannot accord with the monstrous position, that the impure branchial water, deprived of its oxygen by the cilia, and of the alimentary matters by the *palpi* of the animal, is sent by filtration, even if pores existed, through the gill-laminæ and interbranchial tubes, which are the supports of the delicate blood-vessels for discharge at the anal siphon.

As the capacity of the branchial chamber is at least three times greater than the anal, Messrs. Alder and Hancock must admit that two-thirds of its fluid is expelled agreeably to my theory; it is therefore difficult to conceive a plausible reason why a part of the effete water, only one-third, should be got rid of by an issue, termed by them a branchial current. The sustentation and aëration being unquestionably effected in the branchial vault, we may inquire, what is the object of this partial labyrinthine exit for the water instead of its being wholly ejected by the pedal aperture and branchial siphon, at which it entered, agreeably to the simple laws of nature?

In connexion with these views, I state a fact that may have

some weight even with the sceptical. The longitudinal retractors and transverse muscles of the siphons are of very great power; the office of the latter is to diminish the calibre of the tubes, that, in conjunction with the former, they may effect a more powerful expulsion of the impure fluid. As proof, if a dozen *Pholas dactylus* are placed in a large dish of sea water, they will cause so great an ejection from the siphons, not from the effect of sudden disturbance or being startled, but of regular periodical emissions, as to cover the table several times during the twelve hours of the day and also throughout the quietude of the night: assuredly this circumstance serves to prove that the impure water is thus expelled, and that no part of it permeates the interbranchial tubes.

However, it still appears that Messrs. Alder and Hancock insist on a regular in-current by the branchial siphon, and an ex-current from the anal, effected by *cilia*, for the use of the respiratory apparatus; these are, as I think, strange and impotent motor agents. I have in a former paper expressed a belief that the function of the cilia is to beat and subdivide the water, that the oxygen may be the more easily extracted. I must now observe that all the testaceous Mollusca have many parts of their bodies clothed with cilia, which show their action in a similar manner to the Bivalves; what then, in them, are the functions of these appendages? May we not reasonably conclude, the same as in the Bivalves, to extract air from the water not only for their branchiæ, but perhaps to pass the vital fluid through the pores of the body. One can hardly suppose that in either group their duty is mechanically to create currents, when a more simple, visible, and effective plan exists; I therefore think the view is untenable, that they effect the in- and out-flux of water in the anal and branchial chambers. I believe a simple hydrostatic law provides for this operation in all the Bivalves by a vacuum being formed by the contraction of the valves in the expulsion of the effete water, and that on opening them and relaxing the siphonal orifices to take in a fresh supply the vacuum ceases.

The action of the cilia is local. That they produce currents or rather eddies on the gill-laminæ and different parts of the body of the Gasteropoda cannot be doubted; these result from every stroke of each that causes a displacement of fluid which instantly reverts to its level, but they are not the locomotive agents of the entrance or exit of the branchial water; they are strictly particular, having no determinate line of operation, and act indiscriminately from every pole. As presumptive proof, examine an oyster or a mussel from a provincial stall a few days after they are received, when the cilia under the microscope will be found in full action as if just taken from the sea, and will continue so

as long as moisture remains. In this case these species, even if they had siphons, could not produce in- and out-currents by separate ducts, from non-access to water; we are, therefore, bound to give the preference to the idea that their functions are to eliminate the oxygen. I may observe, that cilia are attached to the different epithelia in all animals, from the monad to man. The inconsistency of such a motive power will be apparent from the consideration that the cilia must act antagonistically from opposite points; one set to work the water in branchially, and another to expel it through the anal duct after percolating the gill-laminæ and interbranchial tubes. I shall recur to the cilia, and expect to prove that the new scheme of communication between the two siphons is very problematical, I may say impracticable.

Messrs. Alder and Hancock go on to say, that any one may convince himself of the existence of a branchial in-current and an anal ex-current, by placing a *Pholas* "in a glass of sea water, and then by gently adding a little fresh, slightly charged with floating particles," he will perceive the two actions. I admit, by this process, that currents will ensue, as the invigorating fresh element causes the animal to expel that which has become effete and take in a new supply; but as I have, under every condition of experiment, examined multitudes of these creatures, I am bound to declare that the currents have no *continuous* regularity: and I think the mode of testing their presence by means of the water being charged with buoyant particles is fallacious; these only float on the surface, and are subject to many perturbations and deceptions arising from depth of water, currents of air, the position of the animal, whether on the ventral or dorsal surface, by its will and humour, state of exhaustion, and by an unnatural confinement. My repeated examinations show that the particles are whirled in all directions; sometimes they pass into the branchial chamber, at others none will enter: capricious gyrations, whether arising from the action of the animal or other natural causes, are their ruling character. With respect to the anal siphon, the floating particles are certainly repelled from its orifice in a somewhat regular and continuous manner, being only interrupted by the periodic reception of fluid to supply the exhaustions. The frequent repulsions of particles from the anal orifice have been construed by Messrs. Alder and Hancock to arise from the percolation of water from the branchial vault through the gill-laminæ and interbranchial tubes to an issue at the anal siphon, produced by the agency of cilia. I think it will appear that this complicated operation will meet with insurmountable difficulties, and though I admit the anal outflow, I protest against its being considered of branchial origin and regu-

lar; the regularity is fallacious, though most naturalists appear to have adopted that idea, without perhaps sufficient examination, and others have been careless in their observations. But the diligent observer of cause and effect will perceive that there is as much water inhaled as expelled by the anal siphon, and that its fluctuation in the branchial chamber, produced by the contraction and dilatation of the four gill-plates, which can often be seen by a lens through the orifice of a large *P. dactylus*, aided by the respiratory circulation, causes a pressure and an impulse on the interbranchial tubes; these, as before shown, are filled every two to four minutes by a reception of water anally, which after performing its function, of whatever nature it may be, is thus for a similar period made to reflow into the anal cavity, and from thence is discharged by an insensible contraction of the siphonal muscles until the exhaustion of the fluid: this is very evident by the failure of the current, which only recovers its full action on the periodic renewal of the water. I have thus, perhaps, explained the mystery of the so-called branchial current.

It is problematical what are the precise functions of the water that is received into the interbranchial tubes and anal vault; I have hereafter alluded to some of them conjecturally, and for the present will only observe, that as this tube acts as a conduit to the contents of the rectum, one probable use of the water is to break down and remove the dejections; and it would indeed be strange if it had no other entry, except from the branchial vault by the devious route of filtration through the interbranchial canals.

In further support of the view that the anal ex-current is not the effect of a percolation of liquid through the gill-laminæ, I will for a moment digress, and relate a short incidental experiment. As the anal siphon is somewhat longer than the branchial, it is easy to subject the latter to the influence of the water and isolate the former; it resulted, that whilst the water flowed into the branchial cavity, none, in an hour's constant observation under the lens, issued from the anal siphon, a sufficient proof of the non-communication of the two; but as soon as the anal siphon was allowed to reach the water and obtained a supply, the current recommenced.

I now come to another experiment from which Messrs. Alder and Hancock conclusively infer the connexion of the siphonal currents. They state, "that the nosle of a blowpipe charged with a coloured fluid was placed at the inhalant orifice of a *Pholas*, and immediately a quantity was drawn into the animal. Watching carefully the result, we had soon the satisfaction of beholding a blue-stained stream issue from the exhalant orifice."

To this I observe, that having tried the experiment again and

again, failure always occurred; as the animal, after receiving the coloured fluid, which was applied without difficulty, in general immediately discharged it by the pedal gape, or by the branchial aperture overwhelming with coloured matter both tubes, the orifices of which by their inflection by the animal were so retracted and blended together as to be undiscoverable; of course, any issue of liquid from a particular tube was undistinguishable. When, in any example, the fluid, which was coloured by archil, remained a little time without expulsion, I opened the branchial cavity to see if the gill-laminæ and interbranchial tubes showed any increased inflation or colour from the filtration of the injection, but no unusual appearance presented itself. I also opened the anal vault and collected with a camel's-hair brush as much of the moisture as possible; this was applied to a very small quantity of distilled water, but no trace of colour appeared; we may then presume that none of the injection had passed from one siphon to the other. But when the coloured fluid was administered anally, all the interbranchial tubes were at once filled and remained inflated more than an hour, representing minute well-filled hoses, which bore the pressure of a delicate wooden stylet, and exhibited the fluctuations of the liquid, which, on its removal, instantly reverted to the points of displacement without any escape into the branchial chamber. We may therefore conclude, that the interbranchial tubes are impervious tissues, and are supplied through the orifices of the crypts from the water sucked in by the anal siphon; and one of their uses is probably, by being filled, to afford a sufficient tension to the network of the blood-vessels that they may the better receive the action of the cilia: they may also possibly be the receptacles for the maturation of the ova, agreeably to the opinions of some naturalists; but in the multitudes I have examined I cannot corroborate this view, as during the months of May, June, and July I failed to see any deposit of ova either on the gill-laminæ, or within the interlaminar cavities, or in the crypts of the anal vault; still the "*genitabile tempus*" may be later; nevertheless the ovaria were well filled with germs of various sizes. Under all the circumstances of this experiment, I think, though it may not be impracticable, that it cannot be depended on even if the gill-laminæ are permeable; but as I confidently believe no communication exists through them, I must conclude that these gentlemen were mistaken in supposing they had detected an issue of coloured fluid from the branchial vault through their exhalant siphon.

I have now to consider the principal experiment, which Messrs. Alder and Hancock think will settle the disputed problem of in- and ex-currents in the Bivalves, produced by the action of cilia through separate siphons. They say,—

"But a simple experiment will at once solve this difficulty. Having killed a specimen of *Pholas crispata* with the siphonal tubes contracted as little as possible, and having placed it in diluted spirit a few hours to render the tissues firm without hardening them too much, we had again recourse to the blowpipe, charged as formerly with coloured fluid. The specimen was opened down the ventral margin, exposing to view the whole of the gills stretched along the roof of the branchial cavity. The nosle of the blowpipe was passed into the anal siphon, and on removing the finger from the top of the pipe, the contained fluid immediately filled the anal chamber behind the gills, and then passing at once down the tubes between the laminæ of the gills, issued through ten thousand pores, and dyed the water in the branchial chamber. Thus in an instant the secret was explained;—the currents communicate through minute openings in the laminæ of the gill-plates.

"Having thus satisfied ourselves of this fact, we next directed our attention to the structure of the gills. Accordingly the anal chamber was laid open, and its ventral wall was seen to exhibit four longitudinal rows of large orifices. These four rows of orifices, already well known to anatomists, correspond to the attached margins of the four gill-plates, which hang from the roof or dorsal membrane of the branchial chamber; this membrane being the ventral wall of the anal chamber,—the membrane, in fact, which divides the chambers.

"These orifices lead into wide tubes which pass between the two laminæ forming each gill-plate. These interbranchial tubes lie contiguous and parallel to each other, and extend the full width of the gill, being bifid within its free margin. Thus it is evident that the tubes within the gill-plates communicate freely with the anal chamber. The laminæ forming the walls of these tubes were now examined through the microscope, when the whole was observed to present a regularly reticulated structure composed of blood-vessels; those passing transversely being the stronger and more prominent. The longitudinal vessels, rather far apart from each other, form the meshes into parallelograms. These meshes are open spaces, fringed internally with a narrow membrane and active vibratile cilia. The two vascular laminæ forming the gill-plate are really sieves to separate suspended molecules from the surrounding medium on the passage of the water from the branchial to the anal chamber;—an apparatus of the most exquisite beauty and perfect adaptation to the desired end.

"We cannot understand how this beautiful structure escaped detection by the mercurial injection of Mr. Clark."

I at once dispose of the last remark to save trouble in my

counter-statement; if these gentlemen had read a little more attentively, they would have seen, in the paper on which they have passed their strictures, that Mr. Clark states, "the application of the mercury to that tube gradually filled the entire range of the branchial vessels, which exhibited a very elegant appearance, but no fluid escaped from them into the branchial sac."

It is proper to state, that the *Pholas crispata* is the species that has furnished my controversialists with their remarks on my branchial theory, which is illustrated chiefly by the *P. dactylus*. I am not aware that this circumstance is of much moment, as we may safely conclude that the gills of all the *Pholades* have in essentials the same character. But I ought to mention, that the framework of the respiratory apparatus in some tribes of the Bivalves presents a very different arrangement. For example, there are several British families whose species I have seen alive, and which fortunately can be obtained, that have a peculiar branchial construction, which appears as to *general* configuration closely analogous to that lately described in the 'Annals' to exist in the *Chamostrea albida* and *Myochama anomioides* of authors, but the *particular* parts of the mechanism in my species do not accord; I think the narrow reticulated ribands on the external surface are not permeable, and do not lie on apertures that communicate with the interbranchial tubes. I refrain, at present, from extending these remarks, but in a fitting time I shall be prepared with some comparative notes on certain species that have only a single complete gill-lamina and a rudimentary one on each side the body, which seem to me to differ essentially in structure from the descriptions that have been promulgated on the composition of the branchial mechanism of the species that have been alluded to.

I now enter on the counter-statement to the last quotation, and beg to observe, that Messrs. Alder and Hancock, in the explanatory sketch of their *Pholas crispata*, Pl. XV. vol. viii. N.S., give a very intelligible outline of their theory. Though entirely dissenting from it, I cannot but admire the ingenious delineation, particularly fig. 3. of the gill-laminæ, showing the aspect of the meshes; it has however one fault—it exhibits them *all* with symmetrical longitudinal fissures called "orifices," which I think are ruptures of the membrane of each mesh, not one of which exists naturally in the three species I have examined.

Since May 1853 I have often performed "the simple experiment" detailed by Messrs. Alder and Hancock in the third paragraph of their paper, p. 374; it is by far the most important of the series, as the problem of communication, with them, between the anal and branchial siphons, depends on it:—by the injections of more than 200 *Pholades* with mercury and coloured

fluids, the invariable result has been my inability, as in the first experiments in 1850, to pass the fluids through the anal chamber further than to fill all the interbranchial tubes; but I always found the gill-laminæ, which form their walls, impervious, instead of allowing liquid to issue "from 10,000 pores." It is necessary to state that the numerous interlaminar canals that compose the divisions of the gill-plates are nearly parallel, and hang vertically from the dorsal line, ranging at equidistances throughout a great part of the extent of each branchial plate, and by sutural lines of junction cut off the communication between each tube.

I will now enter a little more into detail on some points in connexion with the branchial laminæ, by describing the appearance of the areas of the parallelograms under repeated examinations by transmitted light, and also as opake objects, rendered so by the injection of mercury.

In a full-grown *Pholas dactylus*, the surfaces of each gill-lamina together comprise an extent of about a square inch, every one-tenth of which contains 400 oblong subquadrangular spaces, or 40,000 in each plate, forming a total in the four gills of 160,000; this admeasurement and enumeration may not be very far from the truth. In each parallelogram, besides a general suboval depression, there are within it five to twenty or more shallow excavations of various size and shape, but there is no ruling symmetrical fissure as delineated in Messrs. Alder and Hancock's fig. 3. Each area shows a plain, a pitted, and a mammillated or traceried surface, detected by the action of the microscopic foci. We will start from the plain surface in which there is certainly no perforation; the fine adjustment of the instrument measures the depth of the depressions, and by another movement shows the character of the minute points, thus proving that no fissure or aperture exists, as when there is really an imperfection in the membrane it cannot thus be resolved, but under every phase of the instrument the hiatus of a solution of continuity is seen. The shallow depressions are the uncovered patches of the membranous base of the scales or epithelium incident to all the Mollusca; from them the numerous vibratile cilia spring which present the most discordant and particular motions that operate from every point; sometimes they appear as if each entire pit was whirled on a vertical axis, at others a compact mass of strands dilates and contracts like the heart, then a fasciculus of cilia is seen beating the water with every irregularity; sometimes only a single cirrhus is raised and falls in quick succession, like a hammer in a mechanic's hand; but it is impossible to describe all the varieties of motion. In a fresh animal the action and strokes exhibit the greatest rapidity; it seems utterly impracticable that

regular currents can be formed by such a chaos of agency; rapidity and diversity is the natural character of the action of the cilia, and it is only by the exhaustion of moisture, which can never occur in natural sites, that a subdued and more deliberate motion is attained, and even then their direction is as variable as ever; I can only consider them as the eliminating mechanism of the oxygen. The epithelium is pretty regularly deposited on the upper area of a compound membrane, one lamina being thin, horny, and of a yellowish pale brown; the other thicker, of a more mucous quality and whiter colour: this is seen by examining the edges of a section. Between these membranes which form the substance of the gill-plates the network of the blood-vessels is spread, as without such support it would fall to pieces: perhaps the roots of the cilia pass through the epithelium and its supporting membrane, and impinging or centring on the coats of the blood-vessels, by a capillary or porous action supply them with the air they extract from the water. It is scarcely possible to view a more interesting object than the structure of the branchial mechanism and operation of the cilia, by transmitted light, under a power of 300 or 400 diameters. I think these data will almost convince naturalists that these organs cannot be the agents of a communication from the branchial chamber to the anal siphon.

It is necessary to state that occasional lesions, and now and then a perforation, are seen on the surface of the gill-laminæ, the evident effect of a casual imperfection; with these exceptions, entirety is the ruling aspect; all my fellow-observers concurred in this opinion; and two pieces of gill-lamina containing several interbranchial tubes were submitted to a distinguished metropolitan microscopist, who thus reported on them: "I can find no pores in them, unless a piece of leather may be called porous." Since this opinion a great number of the gill-membranes of the *Pholas dactylus* have been examined by transmitted light by one of Mr. Ross's microscopes, with the $\frac{1}{2}$ and $\frac{1}{4}$ of an inch object-glasses, a power more than sufficient to detect the presence of natural symmetrical apertures or pores through which *effective* permeation could be obtained; indeed that power would be equal to show pores through which no water could pass freely, and scarcely by exudation.

The gill-plates of the *Pholas parva* are more delicate than in the '*dactylus*.' No appearance of symmetrical apertures exists, but only an excessively minute wiry tracery, studded in the interstices with points, which, under a power of 300 linear, only presented a surface little larger than the point of the finest needle, and had the aspect of prominent dots rather than pores.

In the *Pholas papyracea* the gills are of the finest texture, but

exhibit no appearance of a permeable structure; minute points are scattered in the tracery of the parallelograms, some of them being circled by a shallow grooved line; but this is merely a depression of the epithelium or its supporting membrane. I have preserved the preparations. The *P. candida* has not been examined, and the *P. crispata* does not inhabit the South Devon coasts.

Having mentioned accidental lesions and gill-laminar imperfections, I have to add, that in testing Messrs. Alder and Hancock's chief experiment, no alcoholic injections should be used, as by their penetrating quality they may exude through these supereminently delicate tissues; nor should mercury be employed, as its weight in young subjects without great care often causes ruptures, and from its density it does not pass near so freely as aqueous fluids. Sea water coloured by indigo or archil, or pure, is the proper injection, which must not be pushed beyond a full distension of the interlaminar tubes. The animal should be prepared in as natural a state as possible, and not be killed by any process producing sudden asphyxia, as immersion in hot water or alcohol; the first destroys tenacity in delicate tissues, the second thickens and hardens them too much, and occasions lesions and fissures by contraction. There must be no lesions in the gill-laminæ, except those that result from imperfections, which prevail to more or less extent in every animal I have examined—at least 500; any solution of continuity at the junction of the gills with the excessively delicate membranes of the body will be fatal to success.

If the experiment is thus conducted, no injection through the anal siphon will flow into the branchial vault by the route of the interlaminar canals; the only moisture, if any, that can arrive there, may be a slight exudation, a proportionate one to the number of perforations and cracks in the membrane from laminar malformation, and of these only those which pass through into the interbranchial tubes. There may be in the 40,000 parallelograms in each gill, about twenty flaws or imperfections, and I reserve the possibility that all or most of these may arise from the manipulation of such delicate tissues.

After all these incidents, how am I to explain the great discrepancy between the experiments of the northern naturalists, illustrated by their "10,000 pores," and mine, by the impossibility of causing fluids to issue from the interbranchial tubes by percolation through the membrane on which the network of the blood-vessels is spread? But 'tis said, the sight is keener in the North than with us southrons. The only solution I can offer is a mere guess, that the animals operated on by these gentlemen, after being killed, and alcoholized to harden the

fabric,—and the contractive qualities of alcohol are well-known,—had, when the moisture was evaporated, the membrane of the entire network of the branchial laminæ broken by lesions and contractions, and their fig. 3. in the plate has much the aspect of such ruptures. "I cast this idea on the waters," as Southey did "his little book," and it may have as much value as it deserves. I had scarcely written these lines when I found that my conjecture might be right. Having opened in a gill-plate an interbranchial tube that retained the injected mercury, I cleared it of the mineral, and being dry it was placed in water to recover pliability, for fixing on a tablet, on which it was carefully spread without stretching; I found that in the central portion of the membrane of the plate almost every parallelogram was ruptured, which under the microscope showed no previous solutions of continuity, and each fissure proved a *fac-simile* of those delineated vol. viii. N. S. Pl. XV. fig. 3.

The area of the portion of the plate examined contained about 2000 parallelograms in rows, and by its size caused the sphere of contractibility to centre in the middle, whilst towards the margins, a less resistance and greater elasticity prevailing, many of the rows of network preserved their integrity. I then prepared another portion of ten transverse and as many longitudinal rows; in this diminished area not a mesh was ruptured, and the membrane of the blood-vessels remained perfect. It appears then, that the moistening of the gill-plate with plain water—and of course with alcohol a much greater effect is produced—may have caused all the fissures in Messrs. Alder and Hancock's specimens, thus fully accounting for the singularly different results of our respective injections of the anal siphon.

If I am right in these points, the question of in- and ex-currents by cilia and separate siphons is disposed of. The data of these gentlemen to show a communication between the anal and branchial vaults through the membrane of the network of the gill-laminæ not being tenable, of course their theory falls to the ground, on the principle of "sublatâ causâ tollitur effectus;" consequently mine, as published in the 'Annals,' 1850, has not yet been proved incorrect.

Hitherto the *Pholades* have been more particularly the object of consideration; it may now be not amiss to turn our attention to a group of Bivalves which, though essentially the same, differ materially in the configuration and arrangement of many of their organs; they may perhaps assist us in searching out the truth, by the discordancy of their attributes with those of their precursors.

How am I to consider the *Anomiæ* and *Ostreæ*, that have open mantles and no tubes, in which the water must enter at every

point of the periphery that is patent, contemporaneously with the opening of the shell by the animal? Here the water cannot be passed off by what is called an anal tube, because none exists; it must therefore be discharged by the great ventral cavity. Or, am I to idealize, and suppose that in the same branchial vault a distinct in-current has its course and another out? I may observe, that in the Gasteropoda there is a similar periodic entry and expulsion of water from the branchial chamber as in the Bivalves; and after the cilia have extracted the oxygen, I have witnessed a hundred times the forcible expulsion of the effete fluid by a jet as decided as in them;—am I here also to suppose that there are two distinct opposite currents in the same undivided cavity?

I have now to inquire how the gill-percolation, admitting for argument that it exists, is disposed of in this tribe of Bivalves without siphons. If the water permeates the gills of the *Pholades*, it must do so in the *Anomiæ* and *Ostreæ*; in the former there is a possible vent by the siphon, but none in the latter, therefore it must revert to its source, the branchial cavity. Does not this go far to prove that there is no permeation in either case?

Then, may it not be permitted us, in this asiphonal group, without having recourse to an "*olla podrida*," or hash of currents, to conclude, that when the animal opens the shell for the admission of water to bathe the branchiæ, and when that function is accomplished, it ejects the effete fluid by the same channel it entered, as no separate duct can be found? Will not the calm consideration of this case make most men doubt the existence of branchial currents either by distinct tubes, that is one inhalant and branchial, and another exhalant and anal, or by what I term supposititious ones? The former position I think I have proved in the *Pholades* by showing that there is no effective communication between the two chambers; and in the *Anomiæ* and *Ostreæ*, the latter condition of the currents being imaginary, appears to be the most correct view. It may therefore be considered that in the Bivalves, whatever modification their siphonal mechanism may present, all are subject to a general law of the water being expelled from the same siphon or channel at which it entered, aided by the pedal gape and pedal aperture where they exist; and in the *Anomiæ* and *Ostreæ*, in which these organs are rudimentary or entirely wanting, the water is simply received and expelled through the ventral range, and not by an imaginative inhalant and exhalant regular current, effected by cilia.

The remainder of Messrs. Alder and Hancock's paper requires no further remark than a few words on their concluding experiment, showing how the colouring matters collect in the neighbourhood of the buccal aperture. I have observed these appear-

ances, but I am of opinion, that in an animal cut up from stem to stern, with the so-called in-current, as they admit, annihilated, little dependence can be placed on the action of the gill-laminæ floated in a shallow vessel, to account for the colouring matters seen at its oral termination. And I cannot understand the hydro-pneumatic statics of these gentlemen, nor the position agreeably to their theory, that "a tendency to form a vacuum" in the anal chamber and interbranchial tubes is effected by the "flowing out" of the water from the ex-current siphon, combined with ciliary agency, which actions, they add, are the foundation of their "correct answer to this question; How is the matter, divided into such minute particles, collected on the surface of the gills?"

But a fallacy with respect to a tendency to form a vacuum seems to present itself, as in this case a flowing out involves the idea of a flowing in, which militates against the vacuum, for the fact is, that with the outflow there is in their theory a contemporaneous succession of fluid to compensate any possible exhaustion. One would rather suppose that a tendency to a vacuum, instead of existing in the *anal chamber*, the point of issue, would be formed in the branchial vault, the source of supply, from a possible deficiency of fluid: a river shows no appearance of vacuity at its debouchure or elsewhere, whilst its sources maintain their integrity.

I can conceive in a running stream that the pressure of one portion of water on another produces an impulsion, not a vacuum; but how is this impulsion from mere declivity of gradient to operate in the Bivalves, in which the natural position of the siphons is almost invariably at an angle of 90° in reference to the horizon? How is the flow out of water to be effected in them? Are we called on to believe that the cilia, besides eliminating the oxygen for the blood, perform the function of a pumping apparatus? Surely I need not further entertain such an absurdity; we may therefore conclude that the water is expelled at intervals of two to five minutes from both chambers, by the powerful adductor muscles in combination with the siphonal retractors of the animal operating on the valves; these agents act as a *force-pump*; there is no other adequate exhausting mechanism.

I do not think the idea of ciliary currents, independent of those for the extraction of the oxygen, can be sustained. I also cannot admit, with my views of the impermeability of the gill-laminæ, that the concluding hypothesis of these gentlemen throws "some light on the sustentation of the Lamellibranchiate mollusks;" I believe the gills are strictly a respiratory machine, with the exception that they may be subservient in some or all

the Bivalves to reproduction. I consider that the *palpi* are the purveyors and locomotive agents of the alimentary matters.

As a last argument I submit a syllogism, which perhaps some of your readers will say, from its decisive character, had better have been placed at the head, instead of the end of this paper, and thus they and myself would have escaped the trouble of wading through long accounts of optical and other experimental tests.

In a gill-membrane in which cilia are planted, epithelium is always present, and it and its supporting tissue cannot exist without a membranous and *mucous substratum*; these are absolutely antagonistic to water and impermeable; therefore the gill-laminæ of the *Pholades* and other bivalves are impermeable.

I apprehend, that ciliated mucous membranes are neither absorbents nor emunctories, though the vessels of such glands may pass through them to the surface; they are probably a product by exudation from the blood-vessels, for the formation of an upper membrane and the epithelium. Thus the very constitution of the branchial plates informs the anatomist and physiologist, that there cannot through them be a communication from the branchial to the anal chamber.

It would be lost labour to prolong this disquisition, in which I fear my observations have been too often repeated, but the importance of the problem is my apology. If I have failed to convince, I have at least supplied matter for reflection, which may perhaps lead malacologists to doubt whether the doctrine of inhalant and exhalant currents by cilia and distinct apertures can be maintained against the evidence I have presented, and to admit that this long-entertained theory may prove a delusion.

I conclude with a remark of Sir William Napier, who thus offers an apology—all will exclaim, a needless one—for writing the history of what he terms "a thrice-told tale," the Peninsular War: the eloquent historian says, "that two men observing the same object will describe it diversely, according to the point of view from which either beholds it; in the eyes of one it shall be a fair prospect, to the other a barren waste, and neither may see aright."

Are the northern naturalists and myself in this category? He adds, "wherefore truth being the legitimate object of history, it is better that she should be sought for by the many than by few, lest for want of seekers, amongst false lights, she be lost altogether."

Let us then apply these views, and hope that in this branch of history many observers, besides the present controversialists, will step in to announce the truth and dispel the mists of prejudice.

I am, Gentlemen, your most obedient servant,

William Clark.

XXX.—*On Preserving the Balance between the Animal and Vegetable Organisms in Sea Water.* By Robert Warington.*

In the published notices of my experiments of 1849, to maintain the balance between the animal and vegetable organisms in a confined and limited portion of water, the fact was demonstrated, that, in consequence of the natural decay of the vegetation, its subsequent decomposition and the mucus-growth to which it gave rise, this balance could only be sustained for a very short period, but, if another member were introduced, which would feed upon the decaying vegetation and thus prevent the accumulation of these destructive products—a function most admirably performed by the various species of water-snail—such balance was capable of being continuously maintained without the slightest difficulty; and I may add, that the experimental proof of this has now been carried on, in a small tank in the heart of London, for the last four years and a half, without any change or disturbance of the water; the loss which takes place by evaporation being made up with rain or distilled water, so as to avoid any great increase of the mineral ingredients originally present. It follows then, as a natural deduction, from the successful demonstration of these premises, that the same balance should be capable of being established, under analogous circumstances, in sea water. And in a paper published in January 1852†, I stated that I was, at that time, "attempting the same kind of arrangement with a confined portion of sea water, employing some of the green sea-weeds for the vegetable member of the circle, and the common periwinkle as the representative of the water-snail."

The sea water with which the experiments I am about to detail were conducted, was obtained through the medium of one of the oyster-boats at the Billingsgate fish-market, and was taken from the middle of the English Channel.

My first object was to ascertain the kind of sea-weed best fitted, under ordinary circumstances, for keeping the water clear and sweet, and in a sufficiently oxygenated state to sustain animal life. And here opinions were at variance, for one naturalist friend whom I consulted, advised me to employ the Rhodosperms; another stated that it was impossible to make the red weeds answer the purpose, as he had tried them, and strongly recommended the olive or brown-coloured Algæ; while, again, others thought that I should be more successful with those which had

* Communicated by the Author, having been read at the Hull Meeting of the British Association.

† Gardeners' Botanical Magazine and Garden Companion, Jan. 1852.

in theory first suggested themselves to my own mind, namely the Chlorosperms. After making numerous unsuccessful experiments with both the brown and the red varieties of Algæ, I was fully convinced that, under ordinary circumstances, the green weeds were the best adapted for the purpose.

This point having been practically ascertained, and some good pieces of the *Enteromorpha* and *Ulva latissima* in a healthy state, attached to nodules of flint or chalk, having been procured from the shore near Broadstairs, several living animal subjects were introduced together with the periwinkle. Everything progressed satisfactorily, and these all continued in a healthy and lively condition.

My first trials were conducted in one of the small tanks which had been used for fresh water; but as it was necessary, during the unsuccessful experiments with the brown and red sea-weeds, to agitate and aërate the water, which had been rendered foul from the quantity of mucus or gelatinous matter generated during the decay of their fronds, until the whole had become oxidized, and the water rendered clear and fitted for another experiment, it was, therefore, for greater convenience, removed into a shallow earthen pan and covered with a large glass shade to protect the surface of the water, as much as possible, from the dust and soot of the London atmosphere, and at the same time impede the evaporation. In this vessel then I had succeeded perfectly in keeping a large number of beautiful living specimens in a healthy condition up to the close of 1852. I therefore gave instructions for the making of a small tank as a more permanent reservoir, and one more adapted for carrying on my observations and investigations on the œconomy and habits of the inhabitants.

From the experience I had obtained in my experiments with the freshwater tank, I was induced to modify slightly the construction of this vessel; thus, at the back, or part towards the light, the framing was filled with slate in the same way as the ends and bottom; for I had found that the glass, originally employed, very soon became covered with a confervoid growth which had an unpleasing appearance to the eye, and in consequence of which I had been obliged to paint the glass on the exterior to prevent this growth from increasing to too great an extent. It was also an unnatural mode of illumination, as all the light should pass through the surface of the water. The front towards the room and the observer was constructed of plate-glass, the whole being set in a stout framework of zinc, and cemented with what is known under the name of Scott's cement, and which I have found to answer for the purpose most admirably. Within this tank were arranged several large pieces of rock-work, thrown into an arched form, and other fragments

were cemented in places against the slate at the back and ends, and at parts along the water-line, so that the creatures could hide themselves at pleasure; a short beach of pebbles was also constructed in order that shallow water could be resorted to if desired. The whole tank was covered with a light glass shade to keep out the dust and retard evaporation.

With the sea water obtained in January 1852, I have been working without cessation up to the present time, agitating and aërating when it became foul during the unsuccessful experiments on the sea-weeds, but since then it has been rarely ever disturbed; the loss which takes place from evaporation being made up, as before stated, with rain or distilled water.

For a considerable period, after commencing these experiments, I was much troubled to obtain living subjects in a healthy condition, but having alluded to this, and the success of my investigations, in a short notice appended to a paper published in the 'Annals of Natural History' for October 1852, my friend Mr. P. H. Gosse, who was then sojourning at Ilfracombe for his health, offered in the kindest manner possible to supply me with materials, and from that period he has always most heartily responded to my wants. It must not be imagined for a moment that the beautiful creatures I have thus received have been all preserved alive or always quite healthy. In experimental investigations this would be unreasonable to expect, as the very fact of experimenting implies a disturbance of the then state of things. Besides which, from want of a sufficient knowledge of natural history, from want of forethought and experience and other causes, I have lost many very fine specimens; and as the detail of these losses may prevent the occurrence of the like annoyances to others, I shall venture to occupy your time for a short period with their history.

My greatest loss arose from too great an anxiety to transfer the collection I had preserved in a healthy condition to the end of December 1852 into the new tank. As soon as it arrived from the maker's I lost no time in introducing my numerous family to their new abode, and dearly I paid for my precipitancy, for on the next morning I found many of my most beautiful specimens dead; thus I lost two fine Holothurias (*H. Pentactes*), a small freckled Goby (*Gobius minutus*), a beautiful little Pipe-fish (*Syngnathus lumbriciformis*), and several others, and on opening the door of the case the cause of this mortality was at once evident,—an iridescent film of oily matter was floating on the surface of the water, arising from the paint with which the angular joints and edges of the small tank had been coloured not having become sufficiently hardened.

Another source of loss arises from the several creatures attack-

ing and devouring each other, and it therefore becomes a point of great importance—and highly necessary to be carefully observed, where their preservation is an object—to ascertain what varieties may be safely associated in the same tank; as, for instance, I have found that the Shrimps and Prawns attack, and very soon devour, all the larger varieties of Corallines and Polyps, Sabellæ, Serpulæ, Rock-borers, Cirrhipeds, some of the Annelids, many Bivalve and Univalve Mollusks that are unprotected by an operculum, or have no power of closing their valves. The instances which have come under my own immediate observation have been the destruction of the *Pholas dactylus*, *Saxicava rugosa*, *Cypræa Europæa*, and several specimens of Sabellæ, Serpulæ, *Coryne sessilis* and many others.

The common Crab (*Cancer Mænas*) is likewise a most destructive agent; and the tribe of rock-fish, the Blennies, Gobies, &c. are also most voracious, devouring all the varieties of Cirrhipeds, Corallines, Polyps, Annelids, &c.; they will also attack the shrimps and prawns, and even seize upon the horns of the periwinkle, which they bite. If the mollusks do not keep a very firm hold of the rock or tank sides, they are rapidly turned over by these fish on their backs and lie helplessly exposed to their attacks*. It is doubtless their seeking food of this kind which causes these little fish to be so generally found in the shallow rock-pools of the coast. In consequence of these ravenous propensities I have been obliged to establish several small tanks and imitation rock-pools, so as to separate these various depredators from each other: thus in one I have varieties of *Actinia*, Shrimps, Nudibranchs, Holothurias, and some Annelids; in a second the rock-fish, as the Blennies, Gobies, Cottus, with Crabs and *Actiniæ*; in a third Corallines, Annelids, Polyps, Rock-borers, Sabellæ, Serpulæ, Holothurias, and *Actiniæ*.

Another curious instance of loss I may detail which has quite recently occurred, and which may prove interesting; it was in a small rock-pool containing Blennies, Gobies, Crabs, &c. I had procured two live oysters for the purpose of feeding my numerous small fry in these vivaria, and one of these having proved ample for the purpose of one meal, the other was placed on the

* Since the reading of this paper at Hull I have received a Blenny of larger size, being about 3½ inches in length, and although it has become so tame that it will allow itself to be touched by the hand and takes its food from the fingers, yet its destructive propensities are so great, that it very soon killed four small Crabs; and to save three others, of rather a larger size, I have been obliged to remove the Blenny to a rock-pool in association with his own species and a few *Actiniæ*. The only refuge the poor Crabs had was to bury themselves in the sand, and whenever they attempted to move out of their refuge they were immediately pounced upon and only escaped by burrowing rapidly again.

sandy bottom; on the second day after this the oyster was observed to have opened the valves of his shell to a great extent, which were afterwards seen closed, but a small *Gobius niger*, inhabiting the pool, could nowhere be seen. The day after this the oyster was opened for the general feeding, when, lo! within the shell was found the unfortunate *Gobius*, quite dead. Whether this little gentleman had been attracted within the trap by curiosity or the ciliary motion of the oyster, it is impossible with certainty to say; but that he must have seized on some sensitive part of the oyster is more than probable, so as to have caused such a rapid closing of the valves of the shell as could entrap so active a burglar.

Another important point is the gravity of the sea water; this should be very carefully regulated, for it must be borne in mind that many of the marine creatures are supplied by a permeation of water through their tissues or over their delicate and beautiful organs. The specific gravity should not rise above 1026 at 60° Fahr., and a small hydrometer should be at short periods introduced to ascertain that this point is not exceeded, particularly during the hot months of summer. The reduction to this gravity can be readily effected by the addition of rain or distilled water. Many of the creatures will of themselves afford indications of this increase of density; some of the *Actiniæ* will remain closed and become coated with a white slimy covering within which they remain for a length of time, and if the specific gravity of the water be lowered this is very soon ruptured by their expansion, thrown off, and the tentacula become soon extended.

All putrescent matter or excess of food or rejecta of the *Actiniæ* should be carefully removed from the water, as the noxious gaseous compounds generated by the decay of such matters appear to diffuse themselves rapidly through the water, act as a virulent poison, and speedily destroy the vitality of the occupants. Thus many beautiful subjects were lost in a few hours from the introduction, into a small glass jar, of a large Pecten shell, encrusted with corallines, which had become loaded with putrescent matter by partial submersion in a foul muddy bottom.

Great care should also be taken in moving the *Actiniæ* that the foot or sucking disc with which it attaches itself to the rocks, stones, or mud, be not injured, as, when this occurs, they rarely survive, but roll about without attaching themselves, and gradually waste away and die.

With these exceptions then, everything has gone on very satisfactorily, care being always taken not to overload the water with too large a proportion of animal life for the vegetation to balance, as, whenever this has been inadvertently attempted, the

water has soon become foul, and the whole contents of the tank, both animal and vegetable, have rapidly suffered, and it has required some time before the water could be restored to its former healthy condition.

In one of the numbers of the 'Zoologist' of last year, I stated that besides the *Ulvæ*, *Enteromorphæ* and *Cladophoræ*, I had found the *Zostera marina* a very useful plant for oxygenating the sea water; but this observation has reference only to the case of a tank supplied with a ground where its roots will find a sufficiency of food for its growth, as in a clear shingle or sand it soon decays; and it should be associated with such animals as delight in a ground of this nature, as many of the Annelids, Crabs, burrowing Shrimps, &c. There are several interesting observations which have been made from time to time connected with this subject, which I hope to lay before the natural-history world as soon as I can find leisure time for the purpose.

Apothecaries' Hall, Sept. 10, 1853.

XXXI.—*On the Cornbrash of the neighbourhood of Cirencester.*

By James Buckman, F.L.S., F.G.S., Professor of Geology Royal Agricultural College*.

The Cornbrash as it occurs in the neighbourhood of Cirencester, though for the most part a very thin member of the Oolitic series of rocks, yet presents us with many points for consideration of great interest.

In the counties of Gloucester and Wilts it is always found to rest upon a thick bed of Forest marble clay, a section at Kemble, four miles from Cirencester, being as follows in descending order:—

	ft.	in.
1. *Cornbrash*, an oolitic stone, with rough uneven fracture and full of shells	8	0
2. Blue clay without shells) *Forest*	17	0
Siliceous limestone ...) *marble*	6	0
4. *Bradford clay*, very fossiliferous	7	0
5. Great Oolite		

The bed No. 1, which it is our object to describe in the following remarks, though of so slight thickness, is found to be the substratum of large tracts of land, especially in the neighbourhood of Cirencester, Fairford, Cricklade, and Malmsbury; in each case presenting great and beneficial peculiarities of soil, not only when compared with that upon its surrounding forest marble, but also in comparison with other oolitic brashes; indeed, its name "Cornbrash" would appear to have been given to it from the fact that its soil affords a brash or stony soil

* Read to the Cotteswold Naturalists' Club, Sept. 20, 1853.

favourable for corn crops, which is far from usually being the case with those either of the Inferior or Great Oolitic beds; indeed our observations of crops upon what the Cotteswold farmer calls "stone brashes" of the district, when compared with the Cornbrash, would lead us to conclude the following as a fair average grown upon an acre in bushels:—

	1. Stonebrash, Inferior Oolite.	2. Stonebrash, Great Oolite.	3. Cornbrash.
	Bushels.	Bushels.	Bushels.
Wheat	15 to 20	20 to 25	25 to 30
Barley	25 to 30	30 to 35	40 to 45
Oats	25 to 30	35 to 40	45 to 50

The average rent may perhaps be gathered from the following table:—

	the acre.
1. Stonebrash, Inferior Oolite	7*s.* to 20*s.*
2. Stonebrash, Great Oolite	14*s.* to 25*s.*
3. Cornbrash	20*s.* to 40*s.*

This great difference in the productive powers of soils, which a cursory examination only would lead to the conclusion were nearly alike in character, may, to a considerable extent, be explained by the following analyses, which were made by Professor Voelcker from specimens which I had the pleasure of procuring for him; and it may be remarked in passing, that as the analyses were made by the Professor in order to ascertain the different constituents of the rocks and not the soil, in each case typical hand specimens were presented to him, and the result singularly explains observed facts with regard to the crops upon the respective substrata.

Result of analyses by Professor A. Voelcker:—

	Inferior Oolite.	Great Oolite.	Cornbrash.
Carbonate of lime	89·20	95·346	89·195
Magnesia	·34	·739	·771
Sulphate of lime	·09	·204	·241
Oxide of iron			
Alumina	4·14	1·422	2·978
Phosphoric acid	·06	·124	·177
Soluble silica	2·75	1·016	1·231
Insoluble siliceous matter	3·27	·533	4·827
Alkaline salts	undetermined.	undetermined.	undetermined.
	99·85	99·384	99·420

These analyses show that the phosphoric acid and sulphate of lime—two important chemical agents in the growth of crops—greatly predominate in the Cornbrash; and besides this, the thickness of Cornbrash soil is always greater than that upon the Stonebrashes, as this rock more readily breaks up and becomes disintegrated by atmospheric action.

These remarks tend to show the great practical advantage of geological and chemical knowledge, and fully explain how a successful farmer near Cirencester has converted a "brash farm" —which is in general a term of reproach—into one of the most productive farms in the district, this brash being the fertile Cornbrash.

But not only is this thin stratum of interest on account of the fine crops which it yields, but it will ever present a charm to the geologist from the rich harvest of fossils which it everywhere contains; indeed, the reason why it crumbles down so readily is probably owing in part to its being composed of shells, which are merely cemented together by a calcareous matrix, whilst the phosphates of the rocks are doubtless derived from its imbedded animal matter; hence our examination has not only afforded a tolerable list of species, but several forms are numerically so great, and offer so many curious types, as to deserve a more attentive study than has yet been accorded them. Now in giving an account of the fossil contents of the Cornbrash, it must be understood that my facts are solely derived from observation in the quarries of my more immediate district and are consequently incomplete, and as a lengthened list of fossils could only be the more tedious the more copious its details, I propose in this place to append a mere summary of its remains, making remarks upon its more interesting palæontological features.

Summary of Cornbrash Fossils from the neighbourhood of Cirencester.

	Species.
1. Brachiopoda	7
2. Conchifera	30
3. Gasteropoda	10
4. Cephalopoda	3
5. Annelida	4
6. Zoophyta	3
7. Echinodermata	8
	65

An interesting feature in the natural history of the Brachiopoda, is that five forms of *Terebratula*, namely the *T. lagenalis, sublagenalis, obovata, ornithocephala,* and *digona* of authors (see Davidson's memoir on Oolitic Brachiopoda by the Palæontogra-

phic Society), are all referable to one species; this is a fact arrived at by a comparison of hundreds of individuals, and that the author just cited seems to have almost arrived at when he says, in his description of *T. lagenalis*, "This species has little to distinguish it from *T. ornithocephala*, into which it seems to merge by insensible passages," p. 42. As regards *T. sublagenalis*, the same author remarks, "This species is always accompanied by *T. lagenalis*, of which it may perhaps only be a variety," p. 43; and further, "It is not difficult to find species uniting *ornithocephala* to *lagenalis*, and this last to *sublagenalis*; but as the typical shapes of each are well distinguishable, it will be found convenient to retain them under distinct specific names." The *Terebratula digona*, he says, "often approaches in general form and convexity certain specimens of *T. obovata*."

Here then a wide subject for discussion seems to be opened up; for if we are to found specific names upon *typical* specimens, the question is, where are we to stop? certainly in the case before us, not with five species. And again, if we admit the specific identity of the five types under discussion, is it not probable that even these are but derivative forms that may, in like manner, be identified with others? Our own materials certainly tend to this conclusion.

In this district the five forms quoted, though not altogether, yet for the most part, affect distinct localities; hence the *T. lagenalis* and *sublagenalis* will be found congregated in masses in the Fairford quarries, while the *T. obovata*, from being a rare exception with them, becomes the rule between Cirencester and Cricklade. All these, however, are at Malmsbury replaced by the *T. digona*, which, as yet, is the only instance in this district in which I have observed the latter shell straying from the Bradford Clay, of which I have been used to consider it characteristic.

The only remaining Brachiopod I shall here mention will be the *T. intermedia*, 'Min. Conch.' t. 15. f. 8: this is undoubtedly, to say the least, a form of *T. perovalis*. This opinion again is borne out by Mr. Davidson, as he says in his Memoir, p. 53, "*Ter. intermedia* bears some resemblance to *T. perovalis*; some specimens are undistinguishable." Now as this latter is an abundant fossil of the Inferior Oolite as well as Cornbrash, the sequel will show its recurrence to be of great interest.

Our next remarks will be upon the Conchifera, the chief interest of which will be found in the fact, that in our summary of fifty species, twenty-one or nearly half can be identified with Inferior Oolite shells, and those for the most part of individuals which have always been held as highly characteristic of the Lower Oolite beds; this will become apparent from the following

List of Fossils common to the Inferior Oolite and Cornbrash of Gloucestershire.

1. Amphidesma securiforme, Phill. York. (*Gresslya.*)
2. —— decurtatum, Phill. York.
3. —— recurvum, Phill. York.
4. Astarte excavata.
5. Avicula inæquivalvis, M. C.
6. Cardium citronoideum, Phill. York.
7. —— dissimile, M. C.
8. ——, undetermined.
9. Isocardia concentrica. (*Ceromya.*)
10. —— minima.
11. Lima gibbosa, M. C. 491.
12. Modiola gibbosa, M. C.
13. —— plicata, M. C.
14. Mya literata, M. C.
15. Ostrea, undetermined (perhaps several species).
16. Pholadomya Murchisonæ, M. C. t. 545.
17. —— gibbosa.
18. Plagiostoma duplicatum.
19. Pecten.
20. Trigonia costata.
21. —— clavellata.

Here then we have evidence of an older fauna reappearing in force in a newer bed, and that bed of a very insignificant thickness; these facts, while they should make us cautious in assigning limits to the range of fossils, may at the same time account for much of the confusion felt in the history of the Oolites of Britain, which only becomes the greater on comparison with the "*Jurassique*" of the continent.

These remarks are the more pertinent, when it is understood that in Phillips's 'Illustrations of the Geology of Yorkshire,' nearly all, if not every individual species figured as characteristic of the Cornbrash are amongst the more common examples of Inferior Oolite fossils.

Now these species, except in a few instances, are not common alike to the Great Oolite of this district, but a reference to Morris and Lycett's 'Monograph of the Mollusca of the Great Oolite, chiefly from Minchinhampton and the coast of Yorkshire,' will tend to explain how the parallelism of the Inferior Oolite and Cornbrash species of this district could be maintained by the Great Oolite of the more northerly oolitic deposits. In the introduction to the memoir cited, p. 6, are the following remarks:—"The evidence afforded by the few species of univalves which have been forwarded to the authors from Scarborough, through the kindness of Mr. Bean, though not conclusive, tends rather to assimilate them with the Inferior Oolite, and the authors are led to the following very satisfactory explanation. Admitting therefore the parallelism of the deposits containing somewhat distinct faunas in the north-eastern and south-western parts of the present area of England, we are naturally led to infer, either that the physical conditions might be favourable to the continuation of species in one locality, or that species characteristic of an older deposit, in a more distant region, may have migrated and lived on during the formation of a newer de-

posit in another, the conditions having become unfavourable to the perpetuity of their development in the latter deposit over the original region whence they had migrated."

There is now only one other part of our summary of fossils which seems to claim attention, and that is the Echinodermata. Of these at least six out of eight are common to the Inferior Oolite, namely—

Nucleolites = Clypeus.	Holectypus = Galerites.
1. —— sinuatus.	4. —— depressus.
2. —— clunicularis.	5. Acrosolenia hemicidaroides.
3. —— orbicularis.	6. Diadema depressum.

Of these the *Nucleolites sinuatus* and *Holectypus depressus* are highly characteristic of the Inferior Oolite.

In concluding these remarks, it should be understood that they refer only to a limited district. Were our observations extended over the whole range of the Cornbrash, as it occurs in this country, we should doubtless arrive at additional facts, both as regards the structure and agricultural capabilities and also its fossil contents: we may indeed expect the list of the latter to be greatly augmented, and in all probability other species common to the Inferior Oolite will have to be noted in addition to those in our present list.

XXXII.—*On the Teeth of the Pneumonobranchiate Mollusca.*

By J. E. Gray, Ph.D., F.R.S., V.P.Z.S. &c.

The teeth of the *Pneumonobranchiate* Mollusca are exceedingly uniform, when this group is confined to those which have a closed pulmonary cavity, which, in my former arrangement, I called *Adelopneumona*; I now think that the genera which form the other suborder, being unisexual, and having many characters, as well as the structure of the tongue, like those of the *Tæniglossa*, should be arranged with them, near to the *Littorinidæ*, which often pass the greater part of their lives out of water, and have very imperfectly developed gills on the inside of the mantle.

All the genera of the order so restricted have very numerous, nearly similar ctenoglossal teeth, placed in many cross lines on a more or less elongated lingual band.

In some genera the line is straight, in others angularly diverging from the central lines, and in some the series are angularly bent on each side of the central line.

Professor Troschel, who has figured the teeth of some European

and exotic genera, Dr. Wyman the American genera, and Mr. Thompson, who has described the teeth of many of the English genera and species of this order, have shown these peculiarities, and the alterations which occur in the form of the teeth in different parts of the same cross series.

I have examined the teeth of several of the other exotic genera, and find them quite conformable to those of the European kinds. In general the teeth have a broad, expanded, more or less four-sided, oblong base, with a reflexed tip; the bases of the teeth in the same series and of the neighbouring series being close together on the lingual band, so as to form a close-set rasp.

This is the case with the genera *Arion, Nanina, Parmacella, Clypeidella* (*Dussumieri*) of ARIONIDÆ; *Philomycus, Limax, Geomalacus, Vitrina, Helix, Acavus, Arianta, Vallonia, Iberus, Polygyra, Theba, Helicella, Succinea, Bulimus, Partula, Zua, Pupa, Clausilia, Balea,* and *Achatina* of LIMACIDÆ; *Veronicella* of VERONICELLIDÆ; *Onchidium* of ONCHIDIADÆ; *Auricula, Melampus, Alexia, Scarabus* of AURICULIDÆ; *Lymnea, Amphipeplea, Bulimus, Physa, Coretus, Segmentina, Ancylus* of LYMNEADÆ; *Siphonaria* of SIPHONARIADÆ; and *Amphibola* of AMPHIBOLIDÆ.

The only exceptions I have observed are in the genera *Testacellus* and *Peronia*, and the teeth of these animals are exactly similar. They consist of numerous cross series, each series consisting of many teeth, like the other families of the order, but the teeth are far apart, slender, curved, with a blunt, rounded upper and a pointed lower end like a pin, and only attached to the lingual band by a slight process on the inner side of the middle of the tooth.

This difference in the teeth and the peculiar habit of the genus, living as it does on worms, which it swallows whole, induce me to propose to separate the genus *Testacellus* from the *Helicidæ*, and form it into a peculiar family *Testacellidæ*, to which *Plectrophorus* will probably belong, as it has the same sunken lines on the side of its body from the tentacles to the middle of the back; and in the same manner I would separate the genus *Peronia*, which lives on the sea-coast, from the *Onchidia*, which have the normal teeth of the order.

The genus *Parmacella* in *Arionidæ*, and some species of *Helicella* (= *Zonites*) and *Oleacina* in *Helicidæ*, have a much narrower and more elevated recurved apex with a narrow base, and are more distinct from each other in the tongue-membrane, making a kind of transition between the normal teeth of the order and the teeth of the genera *Testacellus* and *Peronia*.

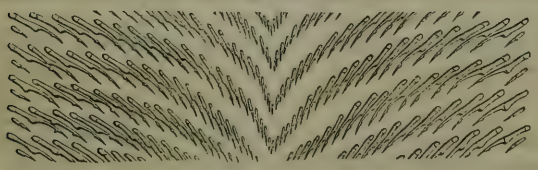
ARIONIDÆ.

The *Nanina Albinensis*, *N. Otaheitana*, and *N. Panayensis* all have very numerous nearly uniform teeth, close together on a very broad lingual band.

Parmacella (*Olivieri*). The teeth numerous in very close cross lines, with a compressed elevated central ridge with a flat edge ending in two teeth.

TESTACELLIDÆ.

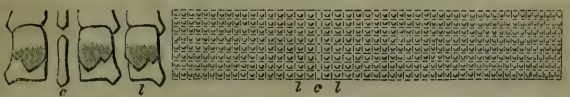
Fig. 1. *Testacellus.*



Lingual membrane broad; teeth numerous in diverging cross series, those of the first six or seven lines yellow, the first darkest, the rest transparent, without any in the central series; the teeth pinshaped, slightly curved, with a roundish head and an acute tip, only attached to the thin lingual membrane by a small central process (see fig. 1).

HELICIDÆ.

Fig. 2. *Achatina fulica.*



In this and the following figures, *c* represents the central, *l* the lateral, and *u* the exterior lateral teeth.

The teeth of all the exotic species I have examined are like those described in the European kinds. I figure the teeth of *Achatina fulica* (fig. 2), as the teeth of that genus have not before been described; they are numerous in each cross series, those of the two central series are small; they are all small, four-sided, rather broader than long, with a blunt rather large central tip.

The teeth of *Partula* (*faba*) are like those of *Bulimus*; they are placed on a broad pale yellowish lingual membrane in numerous straight transverse lines on each side of the central line, and are equal and uniform.

VERONICELLIDÆ.

The teeth of *Veronicella* are very like those of *Bulimus*. The

lingual membrane is broad; the teeth numerous, similar, uniform, in numerous straight cross series on each side of a narrow central equilateral tooth; the lateral teeth are very nearly equilateral, with a broad, flat, subcentral, subequilateral tip.

Onchidiadæ.

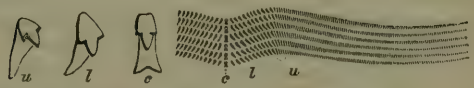
The teeth of a new species of *Onchidium*, very like *O. Celticum*, from the coast of West Africa, are very similar to those of *Helix*, with a short and narrow central tooth in each cross series: the foot of this animal, when preserved in spirits, is quite margined by the mantle and folded across by deep grooves into divisions; the tentacles are completely retractile.

Peroniadæ.

The teeth of *Peronia Mauritiana* are so like those of *Testacellus*, that the description and figure of them will almost suit for these (see fig. 1).

Auriculidæ.

Fig. 3. *Auricula.*



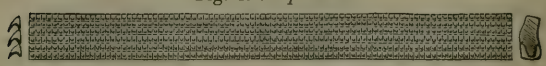
The teeth of *Auricula* (fig. 3) are very like those of *Bulimus*. The lingual membrane is broad, elongated; the teeth numerous, in a slightly bent cross series on each side of an equilateral narrow central tooth; the lateral teeth are rather inequilateral, diminishing in size towards the other edge.

Lymneadæ.

The teeth of *Lymnea, Planorbis, Physa* and *Ancylus* are extremely similar, and have been well described by Dr. Troschel and Mr. Thompson.

Amphibolidæ.

Fig. 4. *Amphibola.*

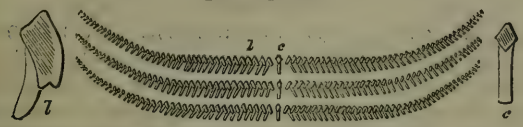


The teeth of *Amphibola nux avellana* (fig. 4) are very similar to those of *Lymnea*. The lingual membrane is large, very broad, expanded and long, with a central space or line scarcely defined; the teeth are numerous, equal, similar, four-sided, rather longer

than broad, in straight cross lines, with a broad rounded lobe, rather more sinuous on the inner than on the outer side of its front edge.

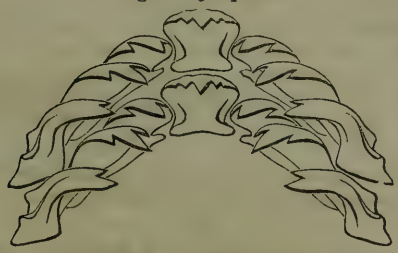
SIPHONARIADÆ.

Fig. 5. *Siphonaria.*



The teeth of *Siphonaria* are on a broad, rather long, dark brown lingual band, are numerous, equal, in a slightly arched cross line; the central tooth is narrow, elongated, with a small rhombic apex; the lateral teeth are larger, diverging, and gradually diminish in size towards the outer side of the series, and furnished with a rather oblique curved tip (see fig. 5).

Fig. 6. *Cyclophorus.*



The teeth of *Cyclophorus Inca* (fig. 6) are similar to those of *Natica* and the other marine genera belonging to the group of *Ptenoglossa.*

XXXIII.—*On the Mechanism of Aquatic Respiration and on the Structure of the Organs of Breathing in Invertebrate Animals.* By THOMAS WILLIAMS, M.D. Lond., Licentiate of the Royal College of Physicians, formerly Demonstrator on Structural Anatomy at Guy's Hospital, and now of Swansea.

[With a Plate.]

[Continued from p. 261.]

Rotifera.—It is the undivided belief of all recent observers that a blood-proper system does not exist in the Rotifera. These animalcules are provided with a rudimentary water vascular system,

which entitles them to rank near the Echinoderms. The cavity of the body is capacious; it is filled with a fluid which is sustained in motion by provisions expressly designed for this purpose. Vibratile 'tags,' accurately described by Ehrenberg and Dalrymple, aided by ordinary cilia on the external surface of the digestive canal, are well fitted for this office. The cavity external to the viscera is filled with a fluid, remarked by all observers, but specially described by none. Its nutritive character may be confidently inferred: 1st positively, from its anatomical locale; 2nd negatively, from the absence of every other fluid. 'Tags' and 'cilia' cannot aërate a vital fluid; they can only set it and maintain it in motion. Confusion has brooded over this simple point. Only the thin structure forming the exterior enclosure of the body intervenes between the fluid of the visceral cavity and the surrounding element. Thus is the former submitted to the influence of the aërating agent*.

Entozoa.—Mystery has long enshrouded the natural history of the Entozoon. Living in situations beyond the access of the atmosphere, and totally uncomprehended in the real character and distribution of its fluids, the mechanism of the respiratory process has proved only the arena for conjecture and speculation as erroneous as various and contradictory. M. E. Blanchard has long misled the helminthologists of Europe. In the Cestoid and Trematoid Entozoa he has pictorially represented a *blood-proper* system of extreme complexity and development. He has figured with elaborate minuteness that which has no existence in nature†. He has confounded an apparatus of irregular, ramifying

* See the excellent Art. *Rotifera,* by Dr. Lankester, in Cyclop. Anat. and Phys. "Contributions to the Anatomy and Physiology of the *Rotifera,*" by Mr. Huxley in Micros. Journal. Annales des Sciences, 1851, Art. *Lacinularia,* par M. Udeken. Leydig on *Lacinularia socialis,* in Siebold and Kölliker's Zeitschrift, Feb. 1852.

† The author would desire to speak with respect of the researches of M. E. Blanchard on the Entozoa. His memoirs on this subject enrich the pages of the 'Annales des Sciences Naturelles' for the years 1847, 1848 and 1849. His illustrative figures, which are copied into Crochard's edition of the 'Règne Animal,' executed in the highest style of French art, are designed to display the true-blood system of the Cestoid and Trematoid worms. With reference to the latter order he remarks:—"Au moyen de mes injections, je me suis assuré qu'il existait chez ces animaux un appareil de vaisseaux à parois propres, se ramifiant dans toute l'étendue du corps. *On ne distingue ici ni veines, ni artères proprement dites; les deux fonctions paraissent appartenir aux mêmes vaisseaux!*"—Is it not extraordinary that such a distinguished physiologist as M. E. Blanchard should offer *such* a definition of any apparatus designed to circulate true *blood*? where in the animal kingdom could a parallel to such a system be indicated?—"Nous le voyons consister en un ou plusieurs vaisseaux principaux, offrant de nombreuses ramifications s'anastomosant sur une infinité de points; en sorte

channels destined to contain a real chylaqueous fluid with a system of *true* blood-vessels. M. Blanchard's inferences are drawn from *injected* specimens. In such investigations the method of injection is liable to numerous fallacies; it imparts a uniform diameter to canals which are remarkable for variety of calibre. The real characters of such structures can only be determined by direct inspection of the living individual. Thus *only* can the fact be demonstrated, that the so-called *blood-vessels* of the parenchymatous worms *neither rythmically contract nor*

qu'il existe là un véritable réseau vasculaire." In principle how totally this definition differs from the former!

Bojanus and Nordmann have described almost in the same words the same system, indicating it as the apparatus for the circulation of the blood-proper. In relation to the Cestoid worms M. E. Blanchard observes: "Pendant longtemps, partageant l'erreur commune, je pensais qu'il n'existait point de système vasculaire proprement dit chez les Cestoïdes. Les canaux gastriques, communiquant de l'un à l'autre dans chaque Zoonite, étaient regardés très-généralement comme destinés à remplir les fonctions des deux appareils. Mais récemment, dans les *Tænias* du chien et de la fouine, j'ai constaté, indépendamment de ces canaux gastriques ou intestinaux, l'existence d'un système vasculaire très-complexe, consistant en vaisseaux longitudinaux pourvus de ramifications et d'anastomoses nombreuses. Ainsi ces animaux remarquables, considérés par les zoologistes les plus éminents comme des Vers *parenchymateux* complètement dégradés, sont au contraire des êtres dont l'organisation est loin d'être très-simple." (Annales des Sciences, tome viii. 1847, p. 119.)

In the *Cestoid* worms M. Blanchard describes a perfect blood-vascular system, independently of that of the straight lateral canals which constitute the gastric apparatus. He describes an artery, a vein, and an intermediate order of straight parallel capillary vessels. In the Trematoda, in one place he states that the extreme vessels form a ramifying plexus; in another he remarks, "Il est à remarquer aussi que les vaisseaux de la partie antérieure (speaking of the vessels in *Amphistoma conicum* (Règne Animal, pl. 28)), et surtout ceux de la partie postérieure du corps, *se terminent sous la peau en de petites lacunes*, du reste très-nettement circonscrites." No instance is known in the whole animal kingdom of a *blood* system terminating in cæcal extremities. The apparatus which exhibits such characters cannot fall under the denomination of a blood-proper system. The method of investigation adopted by M. Blanchard has distorted the features of the object sought to be studied. Forcible *injections* into textures fragile and delicate will enable a preoccupied fancy to construct any results, to recognise grounds for *any* conclusion. The views stated in the text are founded upon examinations conducted with extreme care, and instituted on *living* specimens. To a great extent the author's researches have corroborated the *descriptive* anatomy of M. Blanchard: in many essential respects however they stand in direct opposition. If the system of vessels depicted in the figures of M. Blanchard were really a *true blood system*, the Cestoid and Trematoid Entozoa would be entitled to rank high in the zoological scale. They stand really below the Annelida. To this position they are assigned on the ground of the *general* affinities of their organization. The author is persuaded that the French helminthologist has mistaken a *modified* chylaqueous system for a blood-proper apparatus.

pulsate. Among blood-vessels such a circumstance would constitute an irreconcileable anomaly. The blood-vessels described by M. Blanchard, and in common with him by nearly all helminthologists, in the Cestoid and Trematoid Entozoa proceed from *one or more central spaces*. When these spaces are cylindrical in figure they assume the apparent characters of blood-trunks. They *really* represent the splanchnic or visceral *cavity*. Such is the form under which this cavity, so conspicuous in the Nematoid Entozoa, occurs in the Sterelmintha. The main central channels present a general coincidence of disposition with those of the alimentary system (Pl. XIII. figs. 3, 6, 8, 9). They do not present a uniform diameter according to the customary manner of a vascular trunk. They exhibit irregular outlines, now contracting into narrow necks, and now dilating into lacunæ. This is especially true of those of the Trematoid worms. In the Cestoid orders (fig. 6) the main trunks follow the margin of the "Zoonite," the lesser crossing in the parallel spaces between the transverse annuli into which the integuments are wrinkled. These secondary channels in *Tænia* are much more irregular in outline and distribution than the blood-vessels (*sic*) depicted in the drawings of M. Blanchard: they penetrate intimately the *substance* of the integuments. With reference to these channels, large and small, one important fact should be noted: *they are not gifted with separate membranous parietes*. This fact alone is enough to prove that they are *not* channels for the conveyance of true blood. Every true blood-vessel is endowed with a special power to circulate its fluid contents. Its parietes are *contractile*. The bore of the channel rythmically increases and decreases. Such movements would be mechanically impossible if the parietes of such 'vessels' were adherent to the surrounding solid and fixed tissue. In a channel destined to convey chylaqueous fluid the latter case is the *rule*. They possess no inherent circulating power. *Their* contents are impelled to and fro under the conjoint force of ciliary and muscular action. Here then is a clearly defined distinction between a chylaqueous channel and a true blood-vessel. Let the wonderful vascular system, which M. Blanchard has delineated from artificial injections in the Cestoid and Trematoid worms, be tested by this anatomical principle. This excellent observer has omitted to investigate the histological characters of these parts. He has not in any case determined the relation between that system which he describes as the true blood system and the surrounding solid structures. In no instance has he reduced to demonstration the physical characters of the fluid by which his so-called blood-vessels are filled. The same criticism will apply with equal justice to the illustrations, by aid of which

he defines the alimentary system of *Tænia* and *Bothriocephalus*. The *blood system* described by M. Blanchard in these worms *does not exist*. That which he so beautifully pictures as the *gastric* apparatus, consisting of straight capacious lateral canals, joined by cross conduits, constitutes really an order of passages tunnelled in the solid parenchyma of the body, answering in every sense to a normal chylaqueous system. The contained liquid is not blood, but chylaqueous fluid*: it is a fluid which is devoid of every trace of morphotic elements. *Why* it is so will be immediately understood.

In the Trematoid worms the blood-vessels of M. Blanchard fall unquestionably under the denomination of a chylaqueous system. In *Distomum hepaticum* it is perfectly easy to reduce to demonstration its entire characters. A large median, irregular channel commences in *smaller* passages near the posterior or generative sucker, and proceeds as far as the caudal end of the body of the worm, exhibiting a gradually diminishing diameter. Viewing the object transparently, it may be proved first that this channel is a hollow space by the rolling to and fro of a contained fluid; the movements of the fluid being rendered apparent to the eye by the presence of minute *accidental* molecules. In other respects, it is a perfectly homogeneous non-corpusculated fluid. By Bojanus, Mehlis, Nordmann, and other observers this channel is defined as terminating in an orifice posteriorly, and the channel itself, from the limpid character of its fluid contents, is described as the great duct of an excretory system. This is an error. This system in the Trematoid Entozoa has neither an inlet nor an outlet. It is a *closed* system, but not therefore a blood-system. In *Distomum* there is only *one* central space: it is not a blood-trunk; it represents unquestionably the *visceral cavity*. These worms are not literally therefore sterelminthous, solid, or parenchymatous worms (*Vers intestinaux parenchymateux*, Cuvier). The cavity is *distributed* in form of irregular, imparietal, reticulate passages. These passages can be traced with facility throughout the whole substance of the body. They ramify profusely underneath the skin and amid the digestive diverticula. They arise in the most unequal manner from every point of the circumference of the central trunk. They end peripherally in numerous instances in *cæcal* terminations, corresponding with the mode in which the

* The author is here desirous to explain that he does not deny altogether the existence of a blood-proper system in the Cestoid worms. His researches enable him only to affirm with confidence that *those channels which are described by M. Blanchard* as constituting an independent system of blood-vessels *do not exist*; that his alimentary is really a chylaqueous system, and that his ovarium is truly a grand digestive organ.

blood-vessels (*sic*) of M. Blanchard terminate in *Holostomum alatum, Amphistoma conicum, Tristoma coccineum*; in others they form re-entering branches. The figure of M. Blanchard* represents the secondary trunks in *Distomum* as proceeding from the primary with far too great regularity. To this trunk he seems to indicate a caudal orifice, and yet calls it a *blood-vessel*! It is susceptible of proof that this central channel in *Distomum* is *not contractile*. The adjacent trunks of the *digestive* system contract and dilate in regular periods. The walls of the central channel are perfectly stationary. Its interior is not lined with cilia. Its fluid contents do not move in one systematic orbit: they oscillate to and fro. Such characters can belong only to a chylaqueous system.

In *Holostomum alatum, Amphistoma conicum,* in *Tristomata,* in *Brachylæmus variegatus,* sometimes found in the lung of the Frog and Toad, in *Monostoma verrucosum,* &c., the main primary channels of the fluid system coincide with those of the digestive. The latter are *embraced* by the former. This anatomical fact is significant of a physiological principle. It points to the manner in which the contents of the chylaqueous passages are derived *by exosmosis* from the chymous fluid contained in the digestive cæca. In those species of Trematoid worms in which the central conduits are *more* than one in number, it is important to observe that they are always joined together into *one* system by intervening passages. They do not convey opposite currents. In *both* the contained fluid flows and ebbs with great irregularity, in obedience to the contractions and expansions of the muscular integumentary envelope. In these essential particulars the standard definition of a true-blood system is violated. M. Blanchard defines thus the *Appareil vasculaire* of *Distomum hepaticum*:—"Cet appareil consiste en *un* vaisseau principal et médian." A *true* circulation requires *two* primary trunks, an artery and a vein. In another place this helminthologist observes generally with regard to the Trematoda—"Chez tous ces vers, le sang n'est certainement pas transporté, d'une manière régulière, d'arrière en avant par certains vaisseaux, et d'avant en arrière par d'autres, comme l'a pensé M. Nordmann. Dans les Trématodes en général, le fluide nourricier est transporté et ramené alternativement et plus ou moins irrégulièrement par les mêmes vaisseaux; *c'est un mouvement de va-et-vient plutôt qu'une véritable circulation.*" (Annales des Sciences Nat. tom. viii. 1847, p. 336.) Ample evidence is thus drawn from his own observations to convince the physiologist that the system of vessels

* See plate 36,—Zoophytes: Crochard's French edition of the 'Règne Animal.'

described by M. Blanchard constitutes not a blood-proper but really a clearly defined chylaqueous system. The presence of this fluid implies the existence of a *visceral* cavity : it is its normal anatomical *locale*.

With reference to the blood-proper of the Cestoid and Trematoid Entozoa the author will at present only remark, that *if it exists at all*, it must be under conditions of rudimentary abeyance. The following general statements will then serve to convey the corollaries which his recent researches appear to warrant. In the Cestoid and Trematoid worms the whole substance of the body is pervaded by a highly albuminous but homogeneous non-corpusculated fluid, which is distributed extensively by means of imparietal and irregular conduits under the entire cutaneous surface of the body, *constituting the true apparatus of respiration*, and displaying alternate flux and reflux movements under external muscular agency, and embracing in every possible direction the diverticula of the digestive system, and *from which it extracts its reinforcements*.

It is adequate in every physiological sense to the ends of a nutritive system. Abounding in albumen it is capable of ministering to the wants of the solids. Though destitute of morphotic elements, it yet conforms to all the essential characters of a chylaqueous system.

The *digestive* apparatus (Plate XIII. figs. 3, 6, 7, 8, 9) of the parenchymatous Entozoa is intimately concerned in the process of respiration. In the Cestoid and Trematoid orders it presents but one essential type. It has but one external orifice. A *stomach* properly so called does not exist. There is this remarkable and apparently anomalous fact to be stated with respect to the fluid with which the digestive cæca are filled: —it is charged *with definitely organized floating cells*, which exhibit *constant* differences in different species! These corpuscles are not formless molecules. They consist of a cell-wall and granular contents, and frequently a nucleus legible to the eye. They are flat, scaly particles, having a yellowish tinge. They are undoubtedly *not* fragments from the glandular parietes broken off by pressure. They oscillate with great regularity under the rythmic contractions and dilatations of the parietes of the cæca. It is contrary to no analogical argument to suppose that these floating cells are designed to raise the chyme in which they float to an organic standard above that of ordinary chyme. In the parenchymatous Entozoa they execute the required changes in the nutritive fluids, *while the latter are yet within the alimentary system*. Among the Annelida several exceptions occur in which the same peculiarity is illustrated. The

Nemertine orders (Plate XIII. figs. 1, 2) will be afterwards shown to fall under this category. In *Aphrodita aculeata* (fig. 5, *d*) the digestive *diverticula* are filled with a corpusculated fluid, which is exposed by an express contrivance to the agency of the surrounding aërating medium. This is also the case in several species of freshwater planariform leeches (fig. 4). It prevails too in the true marine Planariæ (fig. 3). To the value which the author has endeavoured to assign to the fluid systems of the Cestoid and Trematoid Entozoa, no sound analogy is opposed. These worms are, on the ground of the interpretation of the fluids now first offered, naturally linked into a continuous zoological chain with the lowest parenchymatous Annelids. Notwithstanding the meritorious researches of M. Blanchard, the organization of the Cestoidea is even now a theme prolific of controversy. The large, branched, flocculent organ (fig. 6) forming the bulk of each segment in *Tænia* and *Bothriocephalus* is designated by all recent writers after M. Blanchard as the ovarian apparatus. It is really the alimentary organ. It opens externally by an orifice proper to each segment. This organ in each segment is therefore independent. It sucks nourishment from without by its own separate mouth. It is a *Planaria in itself.*

What are ordinarily described as the straight canals along either edge of the body are *not gastric* but chylaqueous. They are a part of a system of open channels ramifying through the cells of the parenchyma in which the gastric cæca are lodged. The latter are almost surrounded externally by the fluid filling the former. This fluid, as formerly explained, although non-corpusculated, constitutes the real chylaqueous system of the Cestoid and Trematoid Entozoa. It is through its agency that the breathing function is chiefly accomplished.

In *Tænia* this fluid system is common to the whole body of the animal. The 'segments' therefore are separate units only as respects the alimentary and reproductive organs. The chylaqueous fluid attains its enclosing channels by exosmose from the alimentary organ, not directly *ab extra.* The *posture* of the animal in its native habitat favours this interpretation of its organism. The orifice of each segment is applied to the surface of the infested part. The necessity for the preceding explanation illustrates the intimacy with which the respiratory function is interwoven with all the other nutritive operations of the body. In the *Tæniæ* then the respiration is *cutaneous*, but *not* in the mode commonly supposed. The skin is *not* the scene of a rich plexus of true blood-vessels. It is permeated and pervaded everywhere by that fluid which embraces the alimentary organ, and which is distributed

throughout the parenchyma of the body by means of the irregular canals already described. It reaches the surface sufficiently nearly to receive the influence of the surrounding medium.

It is impossible therefore that the blood-proper can in this worm be the immediate subject of the respiratory process. Its existence is insusceptible of demonstration. If present at all, it can only receive oxygen indirectly through the medium of the chylaqueous fluid. This explanation is simple. It is founded on fact, and supported by analogy. The organization of the Nemertine Annelida conforms in every essential particular to that of the Cestoid Entozoa * (see figs. 1, 2). The latter are illustrated and explained by the former. The ali-

* From the following extracts it will be seen how *little confident*, nay how confused and obscure, the best and latest author appears to be with respect to the real significance of the most important element of structure in the *Cestoid Entozoa* :—" On a généralement regardé les canaux longitudinaux dont il sera question après cet appareil, comme digestifs. Quelques auteurs ont même été jusqu'à leur accorder une, deux ou quatre bouches, par exemple dans les Ténias : tout récemment on leur a attribué une *quasi-bouche*, parcequ'il fallait bien trouver un moyen de faire arriver les aliments dans ces canaux. *Je crois qu'aucune de ces opinions n'est fondée, que ces vers se nourrissent par toute la surface de la peau, et qu'il n'y a pas plus d'organe spécial ou d'appareil particulier pour la digestion que pour la respiration.* Plusieurs anatomistes ont pensé, Rudolphi entre autres, que les segments qui se détachent peuvent se nourrir, pendant quelque temps, par l'ouverture qui s'est formée à la suite de la séparation ; cela me paraît évidemment erroné. Quand ces segments se détachent, le corps s'est resserré de plus en plus au bout, et au moment de se séparer, il ne tient plus que par un mince pédicule !" From the above observations, it is undeniably evident that Van Beneden is perplexed with doubt as to what really *should* be regarded, and what should not, as the *digestive system* in the Cestoid worms. Without a *definitive* knowledge of this system, how is it possible to form a correct conception of the disposition and functions of the nutritive fluids? Nor are the ideas of Van Beneden with reference to the circulating system of these worms more clearly defined :—" M. E. Blanchard croit devoir admettre pour tous les animaux de ce groupe une circulation véritable ayant lieu par des troncs principaux et dans des tubes à parois propres. J'ai étudié, sous ce point de vue, les parties minces et transparentes chez des individus très-frais, et je suis persuadé que le mouvement circulatoire a lieu dans de grandes lacunes, qu'il n'existe pas de vaisseaux à parois propres, et que le liquide correspondant au sang ne peut suivre un cours déterminé ; il y a plus, des brides s'étendant de l'une paroi à l'autre ; elles maintiennent les organes en place, et c'est dans l'espace laissé par les brides que la circulation sanguine s'effectue. Voilà le résultat d'études faites sur des parties vivantes, minces, voisines de la périphérie du corps et sans avoir fait subir aucune préparation à l'animal." " *Je ne crois pas me tromper en disant que les Trématodes et les Cestoïdes n'ont ni appareil digestif, ni appareil circulatoire* " ! !—a conclusion perfectly marvellous, for a comparative anatomist so circumspect and laborious as Van Beneden. The preceding quotations will be found at pages 35 and 36 of his work entitled " Les Vers Cestoïdes ou Acotyles," Bruxelles, 1850.

mentary organ in the Nemertinidæ* is precisely conformable to that of *Tænia*. In the former the whole organ has but one external opening, which is situated, in form of mouth, at the anterior end of the body. In the latter each segment has its separate opening (fig. 6, *a*). In both the digestive diverticula are filled with a corpusculated fluid. In both the spongy tissue, in the midst of which the alimentary organ is lodged, is chambered into capacious areolæ in which the real chylaqueous fluid is observed irregularly to roll. In the Nemertinidæ †, however, the entire external cutaneous surface is ciliated. In the Cestoid worms no vibratile cilia in *any situation* have been proved to exist. It is a remarkable fact, that in *all Entozoa* the ciliary variety of epithelium is entirely suppressed. The agency of these organules is not essential therefore to the process of cutaneous respiration.

The *Trematoid Entozoa* are allied to the Cestoid by the most intimate affinities of structure. In the former type as in the latter, there exists but one orifice to the alimentary system. The gastric diverticula, which in several species amount only to two in number, in all Trematoid orders terminate cæcally. These cæca are filled internally by a corpusculated, and surrounded externally by a non-corpusculated fluid. The oscillations of this latter fluid have been observed by Nordmann, Dugès, Rudolphi, Blanchard, and others. It constitutes the true chylaqueous system. *Such* a development of the blood-proper system in the Trematoid Entozoa is opposed unqualifiedly by the analogy of the whole Planarian family, after whose type the former are constructed. The parenchyma, which intervenes between the digestive system and the external surface in these worms, is loose and large-celled—readily traversed by fluid. This fluid reaches the cutaneous surface; it embraces and laves everywhere the digestive cæca. The Trematoid Entozoa then, like the Cestoid, respire cutaneously. Every spot of the surface is utilized. The

* These Annelids are abundantly illustrated on our coasts by the genera *Borlasia*, *Polia*, and *Lineus*.

† The author is anxious here to bear witness to the excellence of the memoir by M. Quatrefages on the Nemertine Annelids (Annales des Sciences Naturelles, t. vi. 1846), with which he has only just become acquainted. While his essay is acknowledged as a master-piece of minute descriptive anatomy, the author is constrained to differ *toto cœlo* from M. Quatrefages in the physiological interpretation of parts. In these worms the French naturalist indicates correctly the mechanism of the respiratory function:—"Si c'est la surface entière du corps qui joue le rôle d'organe respiratoire, il s'ensuit que la respiration doit s'exercer principalement et plus immédiatement sur le liquide qui remplit les grandes cavités que sur le sang lui-même, puisque celui-ci est renfermé dans des vaisseaux qui sont entourés par le liquide dont nous parlons."—*Op. cit.* p. 269.

chylaqueous fluid is present everywhere, and immediately underneath the cuticle. It moves to and fro in its vacuoles. It is the immediate recipient of the external oxygen. It imparts it secondarily to the true blood, if this exists. Future science may demonstrate that the properties of oxygen are intensified (*ozonized?*) by passage through, or absorption by, a living fluid. Deep meaning may yet radiate from material collocations, over which now chaos broods.

It is a remarkable fact, that the body of every Entozoon, whether imbedded in the parenchyma of solid organs or lodged in the cavitary viscera, is *immersed in a reservoir of fluid.* The *Tæniæ* and *Bothriocephali* are applied *closely to the walls* of the intestine (the orifice of each segment being adherent to the infested surface and surrounded by a mucous capsule filled with fluid). This fact is easily verified in the instance of those species of Cestoid worms which inhabit the intestine of fishes, birds and reptiles*.

The Fluke swims in a pool in the biliary ducts of the sheep. The Trichina in the substance of a muscle floats in a reservoir of fluid, and the Filaria in the cellular tissue is surrounded by a stratum of serous liquid. These enveloping fluids are effused by the living vessels of the part upon which the animal preys. These circumstances present a fact which demonstrates that the life of Entozoa is essentially aquatic. The fluid is no essential constituent of the organism of the parasite. It is extravasated by reason of the irritation excited by the presence, the worm on a living surface, or in the midst of a living organ. It is however a fundamental condition of existence. *It is the medium of respiration to the Entozoon.* How could this vital process occur if the animal were surrounded by a *solid* substance? The fluid contained in these cysts must be *frequently renewed,* because the blood-corpuscles revealed in it by the microscope are always fresh in appearance, plump and perfect in outline. This fact also proves that it is derived directly from the blood of the infested animal; it is therefore charged with oxygen in the same proportion as the latter. Thus is explained an important *external* condition of respiration in the Entozoa.

The *Nematoid Entozoa* (figs. 10, 11 & 12) are distinguished from the parenchymatous orders in one essential respect. In the Nematoidea the viscera float more or less freely in a spacious cavity filled with fluid. They agree in organic type with the cylindriform

* *Bothridium Pythonis* inhabits the large intestine of the Cod.
Acanthobothrium coronatum is found in the intestine of the Ray-fish.
Trienophorus nodulosus lodges itself on the peritoneal surface of the liver of the Perch.
Floriceps saccatus in the intestine of many fishes, &c.

Annelids. From the latter, however, they differ in one extraordinary particular. The Nemertinidæ, Planariæ and Clepsinidæ excepted, in all Annelids the chylaqueous fluid is corpusculated, and the blood-proper is entirely destitute of all morphous particles. In the Nematoid Entozoa *these conditions are reversed.*

In the Cestoid and Trematoid genera the fluid contained in the digestive *diverticula*, through its floating cells, enacts that office, which, in the example of the Nematoid worms, is transferred to the blood-proper, and in that of the Annelids in general to the chylaqueous fluid. This circumstance, however, does not imply that in the Nematoidea the blood-proper system is preponderantly developed. It consists only of two principal longitudinal trunks, adherent at the ventral and dorsal median lines to the internal surface of the integumentary cylinder. Cloquet has described the blood-system in several species. Ecker* has also defined a blood-system in a species of *Filaria*. The blood-*vessels* of the Nematoid worms exhibit a distinct red colour. It is not yet certain that the contained *blood* partakes of the same colour†. Rudolphi has characterized these and all Entozoa as white-blooded worms. The primary trunks are connected together by means of transverse secondary branches: these latter can only be discovered in the substance of the integuments, not on or in the parietes of the viscera. The blood-proper of the Nematoid worms is indeed a very subordinate constituent of the organism, quite insufficient to supply the solids with the materials of increase, and not less unequal to the function of breathing. A few blood-vessels distributed scantily over the cutaneous surface would present too limited a surface of contact with the surrounding element to receive a proportion of oxygen adequate to supply the wants of an organism so large as that of *Strongylus Gigas*. By inference it becomes obvious that some other fluid element of nutrition in these genera is required to minister to the exigences of the solid parts. It is accordingly found that in the Nematoid orders the chylaqueous fluid is relatively abundant in quantity: this fluid is contained, as in the cylindriform Annelids, in the peri-intestinal or visceral cavity (figs. 10, *c*; 11, *d*; 12, *c*). In the round worms this cavity occurs under two distinct anatomical conditions. In one case, illustrated in the example of *Ascaris Lumbricoides* (fig. 11), the intestine is tied by frequent transverse bridles to the integumentary cylinder: these bridles intersect the cavity, and limit the motion of the contained fluid. They stretch outwards through

* Müller's Archiv, Ueber ein Gefässystem in eingepuppten Filarien, S. 506. t. 15. figs. 3, 4, 1845.

† For a further statement of the author's researches on this subject, see his papers in the 'British and For. Med. Chirur. Rev.'

the whole thickness of the integument under the character of transverse muscular fasciculi. They are accompanied by open passages by which the chylaqueous fluid reaches the cutaneous surface for the purposes of aëration. The longitudinal muscular bands, with their embracing spaces, establish between the transverse, free communications. It is thus clear, that although the integuments in certain species of Nematoid worms are remarkably dense and resisting, they are permeated by chylaqueous fluid to an extent enough to subserve the purposes of breathing. The intimate connexion which in some Nematoid worms subsists between the intestine and integument, limits the movements of the intestine. It is to this anatomical circumstance that the motionless state of the chylaqueous fluid in these worms is to be ascribed. In consequence of the absence from this fluid of all visible globules, to detect its existence is not easy to the uninitiated observer.

It is upon the freedom with which the intestinal cylinder moves within the concentric integumentary, in many species of Annelida, that the rapid and unobstructed oscillations of the interposed chylaqueous fluid depends. Why should the same fluid, occupying the same locality, be required to move so little in the Entozoa? The answer probably is, that in the two indicated instances the fluid differs materially in chemical composition. The second type (fig. 10) of Nematoid Entozoa is exemplified best in the case of the large *Strongylus*, constantly to be found in the small intestine of the sheep. Here the intestine, a straight tube, is considerably smaller in diameter than the space included by the integuments, while it is tied at few points to the latter. The visceral chamber is therefore unusually capacious in dimensions, and the enclosed fluid is considerable in bulk. It is a fact of unusual interest, that the chylaqueous fluid, whether stationary or moveable in its containing chamber, of all Nematoid Entozoa, is perfectly homogeneous and destitute of every trace of visible element. In these worms the digestive system does not lodge a corpusculated liquid, of which the suspended cells supersede the necessity for the agency of similar cells in the extra-intestinal chylaqueous fluid. It must therefore be inferred, that the true blood of these worms is the seat of the floating cell agency. If it should be hereafter proved by exact observations, that neither the true blood, nor the chylaqueous fluid, nor the intra-intestinal chyme is charged with floating cells, these animals will constitute an exception unique in the animal kingdom, in which an animal organism is sustained without a single *corpusculated* nutritive fluid.

The principle is at present inadmissible in science, which sup-

poses that the intervention of cells in the nutritive fluids is neither indispensable to the process of solid nutrition nor to that of respiration.

It is a fact of surpassing physiological interest that the chylaqueous fluid in the *Strongylus* of the sheep, which can be collected by spoonfuls, is nothing *but a thick solution of albumen*. After even prolonged standing, it does not throw down the slightest vestige of fibrine-clot. If "the blood" of the infested animal permeated through the integuments of the parasite, and thus reached the visceral chamber of the latter, it appears probable that both the fibrine and the red corpuscles of the former would be capable of detection in the chylaqueous fluid of the latter. This, however, is not the case. The cyst in which *Trichina spiralis* is lodged in the substance of the muscle is filled with a fluid in which both the fibrine and the red corpuscles of the infested animal can be readily shown to exist. The inference is obvious. The chylaqueous fluid of the worm is not derived directly from without by filtration through the partition of the cutaneous structures.

In the order of Nematoid worms, typified by the *Strongylus* of the sheep, the integuments are very thin; the spaces between the circular muscular fasciculi being covered by little more than the epidermis—conditions well-fitted to favour the interchange of gases between the chylaqueous fluid within and the aërating medium without. No indications of vibratile epithelium in any structure in any species of Nematoid worms can be discovered on the general cutaneous surface, dedicated though it be unquestionably to the office of respiration: they exist in no instance. *Why* do they *not* exist? The organic law presiding over the development of these motive organules is still beyond the ken of science.

Henceforth it will not satisfy the physiologist to affirm, in the vagueness of a general phrase, that "the respiration is cutaneous." He must know, with exact definition, by which order of fluids that function is enacted, and whether the living fluid, immediately influenced by the external element, be charged or not with morphous particles. Superstition for ages has wrapped these uninviting beings in unresolvable mist. The assertion has now been abundantly supported, that the process of respiration in *all* Entozoa is conducted on the aquatic model—that the chylaqueous fluid, though non-corpusculated, is by far the most voluminous and important fluid element in the organism, and that which directly performs the function of breathing. The true blood when it exists is only *secondarily* aërated. The 'value' of the respiratory function is directly proportional to the organic

complexity of the fluids. The figure expressive of its amount progresses upwards with the zoological standard of the organism. This principle explains the faculty conferred upon the Entozoon, by a Nature exhaustless in expedients, illimitable in resources, by which it is enabled to extract oxygen enough for *its* wants from the least oxygenated of the animal fluids—venous blood—and securely to breathe amid the pestilential atmosphere of the colonic intestine.

These parasites are capable of sustaining life in any and every recess of the animal body. This fact proves inferentially what the physiologist cannot reduce to positive demonstration, that every part, every fluid, whether in or out of the vessels, is pervaded by the electric presence of oxygen. It proves that the respiratory process is really an inseparable attendant on, and an integral and essential part of, the nutritive actions of the body—that it is ubiquitous, not partial—that it vivifies every constituent atom, fluid, and solid of the entire organism*.

* In order to facilitate the repetition of the observations upon which the general conclusions stated in the text are founded, the author appends here a short list giving the name and place of abode of the most familiar Nematoid Entozoa :—

Name.	Habitat.
Ascaris megalocephala (Cloquet) ...	Intestines of the Horse.
—— *lumbricoides*	Small intestines—Man.
—— *Salaris* (Blanchard)	In intestines of several fishes.
Filaria equina (Rudolphi)	Folds of the peritoneum of the Horse.
—— *attenuata* (Blanchard)	Air-cells of carnivorous birds.
Spiroptera sanguinolenta (Rudolphi)	Stomach of Dog and Wolf.
Spirura Talpæ (Blanchard)	Stomach and intestines of the Mole.
—— *Megastoma* (Rudolphi)	Stomach of Horse.
Oxyuris vermicularis (Dujardin) ...	Rectum—Man.
Sclerostoma Equinum (Rudolphi) ...	Cæcum of Horse.
Cucullanus Percæ (Müller)	Pyloric appendages of common Perch.
Angiostoma entomelas (Dujardin) ...	Lungs of Reptiles.
Cyathostoma lari (Blanchard)	Orbital cavity of Sea-Gull.
Strongylus Gigas (Rud. & Müller)...	Kidneys of Horse, Dog, and Man.
Trichostoma ærophilum (Rudolphi) .	Trachea of Fox.
Trichocephalus hominis (Rudolphi)...	Cæcum of Man.

The order *Nematoidea, Cælelmintha* (Owen), includes the principal internal parasites of the human subject, viz. *Trichina spiralis, Filaria medinensis* (Guinea worm), *Filaria oculi, Spiroptera hominis, Filaria bronchialis, Trichocephalus dispar, Strongylus Gigas, Ascaris lumbricoides*, and *Ascaris vermicularis*. The Entozoa found in the blood have been recently described under the class-name of *Hæmatozoa*. Several species of *Filariæ, Monostomata, Distomata*, and Infusoria, have been discovered in the blood of frogs, dogs, fishes, and mollusca (Micr. Journal, Oct. 1st, 1853).

EXPLANATION OF PLATE XIII.

This plate is designed to express, in outline plans, the natural manner in which the *alimentary* system of the Cestoid and Trematoid Entozoa passes into that of the Nemertine and Planarian Annelida—that they are really constructed upon one and the same principle. Though not represented in this series of figures, the system of the nutritional fluids in these Entozoan and Annelidan groups conforms to one type. The channels for the fluids differ little in distribution from those of the alimentary system.

Fig. 1. Alimentary system of *Nemertes Camillæ*, the cæca (*b*) of which are charged with a *corpusculated* chyme; *e*, space external to the latter system filled with the chylaqueous fluid; *d*, shows that the true alimentary organ of this worm, in common with that of all Nemertine Annelids, is *closed* at *all* sides; *a*, œsophagus entering the proboscis.

Fig. 2. The *caudal* end of the alimentary organ of another Nemertine Annelid, *Borlasia* ——?, proving it to be cæcal also at this extremity: *a*, cavity; *c*, cæca of this organ filled with a corpusculated fluid; *b*, space external to the alimentary cæcum filled with chylaqueous fluid.

Fig. 3. Alimentary system of a *Planaria*: *b*, mouth; *c*, cæca; *a*, areolæ external to the digestive diverticula.

Fig. 4. Digestive system of a freshwater leech, *Clepsina* ——?: *a*, cæca filled with corpusculated chyme.

Fig. 5. Ideal, transverse, section of *Aphrodita aculeata*, showing the distribution of the alimentary system, and its relations to that of the nutritional fluids: *a*, stomach; *b*, visceral cavity; *c*, scales, by the rising and falling of which a strong current of sea-water is maintained through the dorsal channel (*e*), by which current the fluid contents of the digestive cæcum (*d*) are aërated.

Fig. 6. Alimentary cæcum of one segment of *Tænia Solium*: *a, mouth of this segment* leading into a short œsophagus (*b*), and thence into the ramifications (*c*) of the digestive system.

Fig. 7. Alimentary system of a Trematoid Entozoon: *a*, œsophagus; *b*, digestive cæca.

Fig. 8. Ditto of *Amphistoma*: *a*, *b*, cæca of digestive system.

Fig. 9. Ditto of *Bothriocephalus latus* (a sterelminthous worm): *a, mouth of a single segment*; *b* & *c*, cæca of digestive system.

Fig. 10. Plan of a Nematoid worm, showing the great difference between the diameter of the intestine (*a*) and that of the space (*c*) enclosed by the integuments; *b*, reproductive organ.

Fig. 11. Another type of a Nematoid Entozoon (*Ascaris lumbricoides*), in which the intestine (*a*) is larger in diameter, and tied by frequent bridles (*b*) to the dense integuments (*c*).

Fig. 12. Transverse section of the same.

[To be continued.]

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

July 22, 1851.—J. E. Gray, F.R.S. &c., Vice-President, in the Chair.

On the Arrangement of the Edentate Mammalia.

By H. N. Turner, Jun.

In offering to the Society a summary of my observations on the craniology of the Edentate order, I have not so great a number of

hitherto unrecorded facts to bring forward as in some of my former communications. The very remarkable modifications which this order is seen to present, not only in comparison with the rest of the Mammalian class, but also among its own members, and the wonderful variety of extinct gigantic species which the New World has yielded to research, have caused the osteology of the group to be more minutely investigated; while the small number of species and the striking external differences which they exhibit, have left but little room for doubt in the minds of naturalists as to their true arrangement. I will therefore simply point out such of the cranial peculiarities as seem to be characteristic of the order and of its families and genera, dividing it, as appears to me necessary, into five families, since the two forms inhabiting the Old World differ so much from each other, and from the three groups into which those of the New World naturally divide themselves, that although each consists of a single genus, and one of but a single species, it seems requisite that both should stand distinct. It will also be necessary to remodel the genera of the Armadilloes, and to define them anew by their external characters as well as by those of the skull, since the presence of a tooth in each of the intermaxillary bones of a single species of the family has prevented the essential similarities and differences from being duly appreciated.

Although some few naturalists may still associate this order with the true Ungulata, for the sake of keeping the divisions of the class within the predetermined number five, I think that most of those who have given particular attention to the subject will agree, that so natural and strongly-marked a group is well worthy of isolation, which was the opinion of Linnæus and Cuvier, although the former wrongly associated with it a few genera belonging properly to other groups.

The characters possessed in common by the members of so diversified an order, must be expected to be comparatively few; those which I have observed in the skull are as follows:—

The tuberosity of the maxillary bone is articulated by the whole of its upper surface to the frontal and orbitosphenoid bones.

The zygoma is flat and straight, projecting at once outwards and forwards, its articulating surface being more or less confluent with a concavity at the inner side of it which forms a portion of a more or less elongated cone, whose apex would point backwards. In such forms as have the articulation longitudinal, the glenoid surface is distinguishable from that of Rodents by its posterior termination, which is *not* a thin free edge like the anterior.

The alisphenoid bone never extends high, so that the pterygoid ridge forms its upper boundary, or even extends above it.

The absence of enamel in the teeth, when they exist, must also be named among the cranial characters.

Fam. 1. Bradypodidæ.

The intermaxillary bones confined to the lower part of the nasal opening; the maxillary bones provided with simple teeth, shortened,

their malar processes much pushed forwards upon them, and the molar series converging behind; the posterior palatine foramina replaced by a series of minute openings extending the whole length of the palate; the malar bone having a descending masseteric process transversely compressed, longitudinally extended, and with a distinct superadded process arising between its frontal and zygomatic processes; the foramen rotundum distinct, and opening exteriorly at the base of the pterygoid process some distance below the sphenoorbital foramen and anterior to the foramen ovale; the zygoma straight and trigonal, its origin thick and extensive, reaching back quite to the posterior part of the squamous bone; the mastoid bone with a wide digastric fossa, and a strong thick styloid process, terminating in a circular concavity for the reception of the stylohyal bone; the lower jaw widened anteriorly with an extended symphysis.

It must be observed that the superadded process of the malar bone is peculiarly characteristic of this family, and is quite distinct from any of the processes of that bone to which special names have been assigned. It is situated between the frontal or postorbital and zygomatic processes, both of which seem also to exist in a more or less rudimental form in most of the known species; and when the latter is wanting as in the genus *Cholœpus*, the fact that the new process stands aloof, above the zygoma, is enough to prevent its being taken for the zygomatic process, which in all mammalia possessing a complete zygomatic arch either abuts simply against the extremity of the zygoma, or more generally seems to support it from beneath.

The zygomatic process is well developed in the *Megatherium*, and completes the arch, leaving the other, which might be called the supratemporal process, projecting above it. In *Mylodon robustus* the frontal process is reduced to a slight angle upon the base of the supratemporal process. In the *Scelidotherium* the process existing above the zygomatic process appears to be broken off, but the obliquity of its base renders it improbable that it would be the true frontal process so largely developed.

The circular pit for the attachment of the stylohyal bone is precisely similar in the Sloths to that in the large fossil genera, and it is somewhat remarkable that Prof. Owen, while describing the character in these extinct forms, should have made no allusion to its existence in the recent Sloths, even though Cuvier expressly points it out. The tongue is largely developed in this family, and the living sloth may be seen to make great use of it in taking food into its mouth, as was observed by Mr. Ball, in a short communication published in the 'Proceedings' some years back. On the other hand, it is long and slender in the insect-feeding tribes, so that the maximum degree to which it was developed in the *Glossotherium* is certainly no indication that such was the food of that remarkable genus.

Cholœpus, Illiger.

Intermaxillary bones small, produced anteriorly; postorbital process well-developed; malar bone with a well-marked frontal process, but no zygomatic process, the supratemporal process projecting

backwards or bent a little upwards; pterygoid bones inflated; crotaphite impression approaching near to the occipital ridge; tympanic bone reduced to a simple ring; lower jaw produced anteriorly, straight below, its condyle depressed; teeth $\frac{5-5}{4-4}$, simple, rounded, the anterior ones in each jaw enlarged, trigonal.

C. didactylus.

Bradypus, Gray.

Intermaxillary bones reduced or wanting; postorbital process slightly developed; malar bone with the frontal and zygomatic processes slightly marked, the supratemporal process rising obliquely; pterygoid bones inflated; crotaphite impression terminating at a considerable distance from the occiput; tympanic bone well-developed, forming a bulla; lower jaw with a flattened square process in front, deep posteriorly, the lower outline convex, the condyle elevated; teeth $\frac{5-5}{4-4}$, simple, rounded, the anterior ones similar, small in the upper jaw.

B. crinitus.

In addition to the character of the pterygoids, which, in the absence of actual knowledge, might possibly have belonged to age or sex, I find this species to be clearly distinguishable from those of the next genus by the great distance that intervenes between the posterior termination of the temporal fossæ and the occiput, which is much greater in the old specimens even than in the young of the genus *Arctopithecus*. The occiput also differs from them in being proportionally smaller, of a rounder form; the digastric fossæ converging a little superiorly, instead of diverging as in the other genus. The lower jaw also presents a character more decided than the anterior production which Mr. Gray points out in his paper on the genus *Bradypus*: it is much deepened behind, rendering the lower outline very convex. And further, there are certain characters pointed out by Cuvier in the 'Ossemens Fossiles' which appear to be constant, so far as I have been able to observe, as it is only in young specimens that the sutures are discernible. They are, first, that in this species, the *Ai à collier*, the nasal bones are bevelled towards the middle posteriorly, so that they form a point between the frontals, while in the other species they are bevelled in the opposite direction, the frontals descending between their extreme points. Secondly, that the palatine bone forms but a narrow slip within the orbit, and the alisphenoid bone occupies a much larger portion of the temporal fossa than in the other species.

The skull spoken of by Mr. Gray as being taken from a skin, presents characters intermediate between the other one and that upon which the *B. affinis* is founded, therefore I refrain from inserting the latter as a species until further evidences are obtained.

Arctopithecus, Gray.

Intermaxillary bones short and small; postorbital process slightly developed; malar bone with the frontal and zygomatic processes

slightly marked, or the former wanting, the supratemporal process rising obliquely; pterygoid bones compressed and simple; crotaphite impression extending to very near the occipital ridge; tympanic bone well-developed, inflated; lower jaw with its inferior outline concave posteriorly, its condyle elevated; teeth $\frac{5-5}{4-4}$, simple, rounded, the anterior ones similar, small in the upper jaw.

A. GULARIS. *Aï à dos brulé.*

A broad patch of soft yellow hair between the shoulders, and a black line running through it down the back; the upper anterior molars proportionally larger, and the second less, than in the following species; the occiput again affords us a very good distinction, as it is much wider and not so deep as in the following species, and the foramen magnum not so large. Two skulls in the British Museum present these characters, and evidently belong to adult, probably aged, individuals; that of the skeleton, also from Bolivia, seems referable to the other species.

A. MARMORATUS.

Fur everywhere more or less lengthened, no yellow spots, dorsal line grey brown; anterior upper molars very small, the next rather larger than those which follow; occiput deeper and narrower than in the preceding species, its foramen larger.

The *A. Blainvillii* is not distinguishable by external markings, and the skulls bearing that name in the Museum collection all present a general robustness, such as age and sex might very probably occasion. One of them, which, from retaining some of the sutures, seems to be younger than the others, has the frontal bones less swollen, and the lower jaw with its angular process as much produced as in those labelled *marmoratus*, though deeper, but not so deep as in the others.

The *A. flaccidus* may be only a local variety, the skulls not being very clearly distinguishable, for there are not two between which some individual peculiarities may not be traced.

The skull to which the name *problematicus* is given is evidently young, having all its sutures well-marked, and in the absence of the fur cannot be safely looked upon as the type of a species. It agrees with the others in the character of the occiput, which distinguishes them all from the *A. gularis*, as well as from the *Bradypus crinitus*. The palæontologist is well aware of the uncertainty of establishing species upon trivial details of form, although slight distinctions are in some cases known to afford a true indication: the skulls of the Three-toed Sloths vary greatly, and all present a coarse, rough-hewn appearance which must detract from our confidence in little differences of detail. With regard to the lower jaw, they certainly do not present differences so strikingly characteristic as those upon which the species of *Mylodon* are established.

MEGATHERIUM, Cuvier.

Intermaxillary bones lengthened and prominent; postorbital process lengthened and drawn out, but not inflated; malar bone with its

frontal and zygomatic processes well-developed, the latter attached firmly to the zygoma; the supratemporal process rising obliquely; pterygoid bones compressed, and not inflated; crotaphite impression approaching near to the occipital ridge; tympanic bone attached, small, and not inflated; (immediately in front of the circular facet for the stylohyal bone there descends a strong process, which may probably belong to the tympanic bone and form a portion of a vaginal process;) lower jaw produced in front, deepened in the middle by the extensive implantation of the molars, the condyle much elevated; teeth $\frac{5-5}{4-4}$, quadrate, grooved transversely on the crown when worn, the cæmentum being thickened on the anterior and posterior surfaces; the posterior upper one small.

M. Cuvieri.

Dr. Lund figures a tooth having the characters of this well-known genus, but of smaller size, under the name of *Megatherium Laurillardi*.

Megalonyx, Jefferson.

General cranial characters unknown; teeth $\frac{?-?}{4-4}$, subelliptical, with a ridge on the inner side.

M. Jeffersonii.

Mylodon, Owen.

Intermaxillary bones small (lost in the skeleton); postorbital process but little developed, thick; malar bone with the frontal process indicated by a slight angle, the zygomatic well-developed, touching the zygoma, the supratemporal process rising obliquely; pterygoid bones thin and compressed; crotaphite impression approaching near to the occipital ridge; tympanic bone reduced and separate; (the foregoing characters can of course apply only to the *Mylodon robustus*, it being the only species of which the cranium is known;) lower jaw broad and more or less prolonged in front, the lower outline straight, the condyle depressed; teeth $\frac{5-5}{4-4}$, the anterior ones rounded or trigonal, the posterior ones larger, trigonal in the upper jaw, gradually becoming bilobed in the lower. The species can only be characterized by the lower jaw, as it is the only part that is known in all of them. The characters are taken chiefly from Prof. Owen's works.

M. Darwinii.

Lower jaw much produced anteriorly, with a double mammelliform tuberosity upon the symphysis below. The first tooth rounded or subtrigonal, the second subelliptical, with a slight depression on the inner side; the third subquadrate, grooved on the inner side; the posterior internal angle produced; the fourth bilobed, sharply grooved on the inner side.

M. Harlani.

Lower jaw with the symphysis short; the second tooth subquadrate, grooved on the inner side, with the posterior internal angle

produced; the third trapezoid, obliquely placed, with the inner side rounded; the fourth bilobed, the inner groove biangular, and a small shallow one anterior to it.

M. ROBUSTUS.

Lower jaw produced and very broad anteriorly, the first tooth round, the second subtrigonal, grooved internally, the third subquadrate, oblique, the fourth bilobed, with a deep scallop on the inner side and a smaller one anterior to it.

GLOSSOTHERIUM, Owen.

Crotaphite impression approaching near to the occipital ridge; tympanic bone reduced and separate. The general cranial characters are unknown, but the fragment is recognizable by the great size of the surface for the stylohyal bone, and of the precondyloid foramen.

SCELIDOTHERIUM, Owen.

Malar bone with a well-developed zygomatic process; the character of its frontal process cannot be determined through mutilation of the specimen; crotaphite impression approaching near to the occipital ridge; tympanic bone reduced and separate; lower jaw greatly curved below, its condyle depressed; teeth $\frac{5-5}{4-4}$, transversely extended, the anterior ones fully as large as the others, the first in each jaw elongate trigonal, the others gradually becoming bilobed, the last upper one trigonal.

S. leptocephalum.

PLATYONYX, Lund.

This genus is proposed by Dr. Lund, to include a series of species discovered by him, the first three of which he had previously referred to the genus *Megalonyx*, and Prof. Owen, in the conspectus at the end of his memoir on the *Mylodon*, has placed them in his genus *Scelidotherium*; but I prefer to adopt, for the present, Dr. Lund's latest arrangement, since in the lower jaws figured, the last lower molar has a deep groove on its posterior side, and the fourth species, of which an entire skull is figured (tab. 38), agrees in this character, and shows a marked distinction from the *S. leptocephalum* in the zygomatic arch being incomplete; the malar bone has no frontal process, and but a slight angular indication of the zygomatic process.

P. Cuvieri. *P. minutus.*
P. Bucklandi. *P. Brongniartii.*

In addition to these, Dr. Lund represents a metacarpal bone of a species which he calls *P. Owenii*, and an os scaphoides of the foot of another, which he names *P. Agassizii*.

The genera *Cœlodon* and *Sphenodon* of Dr. Lund seem open to the objection suggested by Prof. Owen, namely that the teeth would be first developed in the form of hollow obtuse cones, not assuming the cylindrical form until worn down to the part which has acquired

in process of growth the normal thickness; but while I feel naturally cautious of introducing into my category any genera or species, the establishment of which is not made fully satisfactory to my mind, I must not be considered as rejecting any of those of Dr. Lund, when his illustrations and lists of names are the only evidences I can attain; since his original specimens are far beyond my reach, and my ignorance of the Danish language prevents my comprehending his descriptive memoirs.

Fam. 2. Dasypodidæ.

The nasal bones long, of nearly uniform width, their extremities projecting forwards beyond the intermaxillaries; the intermaxillaries are portions of cylinders, reaching further especially on their palatal surface than in the other families; the maxillary bone swollen and provided with simple teeth; its zygomatic process projecting boldly outwards, and a ridge continued from it for the masseter, the molar series diverging behind; the posterior palatine foramina are replaced by a row of minute openings extending the whole length of the palate; the malar bone, when there is a descending masseteric process, or a rudiment of one, has it compressed longitudinally, extended transversely; the foramen rotundum is included in the foramen spheno-orbitarium; the zygoma is flat, gently twisted upwards towards its extremity; the mastoid bone with a deep narrow groove, containing one or more mastoid foramina; the basi-occipital bone with a transverse depression just anteriorly to the edge of the foramen magnum, and (excepting in the genera *Tolypeutes* and *Glyptodon*) with an articular surface upon the lower edge of that foramen receiving the odontoid process of the axis when the head is deflexed; the occipital condyles are portions of cylinders, placed horizontally, each in a line with the paroccipital process; the precondyloid foramen is placed close to the condyle; the supra-occipital bone is broad above, forming on each side a strong thickened ridge; the lower jaw is narrowed and slenderly produced anteriorly.

The true affinities existing among the various Armadilloes have been rightly perceived by the Baron Cuvier, and are well pointed out in the 'Ossemens Fossiles'; but he did not designate the subgenera by any particular names, and naturalists, for the most part, have adopted the arrangement of Mons. F. Cuvier, which limits the genus *Dasypus* to the single species that has teeth in the intermaxillary bone, and unites all the rest, excepting the Giant Armadillo, under the generic name *Tatusia*. Mr. Gray, in the 'List of Specimens of Mammalia in the British Museum,' has adopted in addition the genus *Xenurus* of Wagler, and it will be further necessary to make use of Illiger's genus *Tolypeutes* for the Apara or Three-banded Armadillo. The species *villosus* and *minutus* must be associated, as Baron Cuvier has done with the *Encoubert* in the genus *Dasypus*.

The groups recognized in the 'Ossemens Fossiles' being thus restored and the names proposed by other authors applied to them, I shall proceed to characterize them by their external armour, by which they may very easily be distinguished, and to add the cha-

racters of the cranium, in which my observations have been assisted by the immortal work alluded to.

TATUSIA.

Ears thrown backwards and approximated; plates of the head of irregular shape and smooth; those of the scapular and pelvic shields much smaller than those of the bands, and surrounded with others smaller still; fore-feet with four toes, the claws straight, the index and medius nearly equal, the pollex and annularis small; maxillary bone terminating in a pointed process behind; teeth rather small, none of them being further back than the root of the malar process; this process concave anteriorly, projecting outwards and backwards; the infra-orbital canal entirely below it; malar bone simply a portion of an inverted arch, hollowed on the outer side for nearly its whole length by the masseteric impression, merely abutting against the zygoma; palatine bone reduced in vertical extent, being encroached on above by a large thickened portion of the ethmoid bone which appears in the orbit, the sphenopalatine foramen being a narrow fissure between them; pterygoid bone simply bordering the termination of the palatine, without hamular process; zygoma compressed and elevated, its glenoid surface circular; tympanic bone reduced to a ring; mastoid narrowed; lower jaw slender, its condyle but little elevated, transverse and flat, coronoid process elevated.

T. SEPTEMCINCTA.

Ears about one-third of the length of the head; plates smooth; tail as long as the body.

T. affinis of Dr. Lund may possibly be identical.

T. HYBRIDA.

Ears about one-fourth of the length of the head; plates of the pelvic shield convex and elevated; tail about two-thirds of the length of the body. The characters of this species, which was named by M. Desmarest, are carefully pointed out by Mr. Martin in the 'Proceedings' of the Society, January 1837.

Cuvier speaks of a third species brought from Brazil by M. de Saint-Hilaire, under the name of *Tatou verdadeiro*, differing from the mule Armadillo in having the tail terminated by a horny sheath of one piece, the bands broader, and the plates of the pelvic shield larger.

Dr. Lund figures two ossicles of a *Tatusia*, indicating dimensions much greater than those usually attained by specimens belonging to the genus, and applies the name *Dasypus punctatus*. I find in the Museum of the College of Surgeons a recent carapace, denuded of its horny epidermal scutes, and wanting the scapular shield; it is as large as Dr. Lund's figures would imply, and has the same punctate depressions in the grooves which mark the surfaces of the component ossicles. It differs from a smaller one, still a large specimen, also denuded of the epidermal scutes, in the latter having the central area of each ossicle a little elevated at its posterior margin, and the punc-

tate depressions fewer and smaller behind this area than in front of it; while in the larger specimen they are all about equal in size.

It is difficult to compare these specimens with those which retain their natural covering; but the punctate character seems to belong to the genus rather than to the species, it not being perceptible until the horny scutes are removed: and whether the *Tatusia punctata* be a species, or merely a large variety of one of the others, it would appear not to be extinct.

Chlamyphorus, Harlan.

Plates of the head, the scapular shield and the body forming an uninterrupted series, each a parallelogram, those of the neck smaller, and those of the muzzle irregular; pelvic shield small, flat, or slightly convex, placed vertically, at right angles to the dorsal armour, and composed of concentric semioval rows of trapezoid plates; fore-feet with five toes, the medius being the longest, the two inner claws the smallest, and the three outer ones very deep and compressed; frontal bone with a large thickened process above the eye; malar bone thin, deep anteriorly, with a rudiment of a descending masseteric process assuming a transverse position; auditory process bending forwards round the base of the zygoma; lower jaw with the ascending ramus much elevated, the condyle higher than the coronoid process.

C. truncatus.

Dasypus.

Head broad behind, ears wide apart, its plates irregular, marked like those of the body; those of the scapular and pelvic shields oblong parallelograms, like those of the bands, but becoming pentagonal or hexagonal towards the neck and croup—all the plates marked with an indented pattern; bands about six or seven; fore-feet with five toes, the index nearly as thick as the medius, which is the longest, the claws a little twisted outwards; maxillary bone terminating behind in a strong vertical column formed by the alveolus of the last tooth, and concealing the sphenopalatine and pterygo-palatine foramina; teeth rather large; malar process compressed in the antero-posterior direction, suddenly projecting, concave anteriorly; infra-orbital canal short, pierced through the base of the process; malar bone angular, with a rudiment of a descending process, compressed in the antero-posterior direction; its zygomatic process deep, extending beneath the zygoma; palatine bone ascending into the orbit; no appearance of the ethmoid within the orbit; pterygoid bones with well-defined hamular processes, bent outwards; zygoma well-developed, flat; its glenoid surface slightly convex, reniform; tympanic bone well-ossified, forming a bulla; auditory process largely developed; mastoid bone very broad, placed entirely in the occipital region; lower jaw deep and thick, its ascending ramus high; coronoid process largely developed, condyle broad.

D. sexcinctus.

Muzzle broad; plates large, distinct, but slightly indented; bands six or seven, *no* separate band on the anterior edge of the scapular

shield; terminal plates of the bands and pelvic shield small; hairs few, white; teeth $\frac{9-9}{10-10}$, the first upper one on each side being in the intermaxillary bone.

D. VILLOSUS.

Muzzle broad; plates closely united, roughly tubercular, those of the bands closely united and small; bands eight; a separate band on the anterior edge of the scapular shield, behind the row of nuchal plates; terminal plates of the bands and pelvic shield large and falcate; hairs profuse, brown.

D. MINUTUS.

Muzzle tapering, narrow at the end; plates of the head smooth, those of the shield and bands closely united, and flatly tubercular; terminal plates of the bands and pelvic shield large and falcate; bands six or seven; a separate band on the anterior edge of the scapular shield, behind the row of nuchal plates; upper parts with black hairs; sides of the head and limbs with brownish hairs; under parts with whitish hairs; teeth $\frac{8-8}{9-9}$, none in the intermaxillary bones, nasal and intermaxillary bones lengthened.

XENURUS, Wagler.

Head broad behind, ears wide apart, its plates irregular, smooth; those of the scapular shield irregular in the middle, hexagonal towards the sides; bands twelve, composed of short and square plates; pelvic shield with square plates in the middle, becoming hexagonal towards the sides; tail almost naked; fore-feet with five toes, the index longest, but very slender, the three outer toes rapidly diminishing in length, but furnished with large claws, twisted outwards; maxillary bones articulated posteriorly by suture to the palatine, its malar process thick, rounded anteriorly; malar bone but slightly angular, its zygomatic process extending beneath the zygoma; palatine bone ascending into the orbit, and pushing up the sphenopalatine foramen into a fossa which contains the foramina of the orbit; pterygoid bones with their hamular processes styliform, projecting backwards; zygoma small, rounded above; tympanic incompletely ossified; mastoid bone broad, placed obliquely; lower jaw slender, its condyle elevated, reniform; coronoid process feebly developed, lower than the condyle.

X. UNICINCTUS.

Cuvier mentions a species with a shorter and more entirely naked tail; it is probably the same that has been called *nudicaudis* by Dr. Lund. *X. antiquus* of the same distinguished author may possibly be identical.

PRIODONTES, Frederick Cuvier.

Head broad behind, ears wide apart; plates of the head and body as in *Xenurus*; tail closely covered with quadrangular scales, placed in a quincuncial arrangement; fore-feet as in *Xenurus*, the outer toe

much reduced; maxillary bone articulated posteriorly by suture to the palatine; teeth numerous and minute; infra-orbital canal long, commencing below the malar process, and terminating nearly on the middle of the bone; malar bone forming simply a portion of an inverted arch, round, and devoid of processes; palatine bone ascending into the orbit; pterygoid bone strongly developed, with an angular termination; zygoma rather small, the glenoid surface lengthened, the lower part of the squamous and the alisphenoid bone forming a longitudinal swelling within it; tympanic bone small, and loose; mastoid bone broad, forming the sides of the occiput which are rounded; lower jaw thin and compressed, condyle longitudinal, but little elevated; coronoid process much reduced.

P. gigas.

Tolypeutes, Illiger.

Head broad behind, ears wide apart; plates very closely articulated to each other, their surface divided by impressed marks, and studded with blunt tubercles, those of the scapular and pelvic shields varying from a square to a pentagonal or hexagonal form; bands three, composed of oblong parallelograms, equally subcircular, and closely articulated; fore-feet four-toed, the outer being absent; the medius slightly longer than the index, with a much larger claw, both having an outward twist; maxillary bone articulated posteriorly to the palatine, its malar process standing suddenly outwards, compressed; infra-orbital canal commencing below and behind its root, rather lengthened, rising a little in its course; teeth rather large; malar bone slender, and simply abutting by an oblique suture against the zygoma; palatine bone ascending into the orbit, pterygoids with blunt hamular processes, a little bent outwards; zygoma rather narrowed, glenoid surface flat, reniform; tympanic bone reduced to an annular form; lower jaw slender, condyle moderately elevated, reniform, coronoid process elevated.

T. tricinctus.

Cuvier cites the *Cheloniscus* of Fabricius Columna as being this species, but represented with four bands instead of three; the last row of plates of the scapular shield is composed of oblong parallelograms like those of the bands, which may have given rise to such an error.

Chlamydotherium, Lund.

Judging by the plates that accompany Dr. Lund's Memoir, this appears to be a genus of extinct gigantic Armadilloes, having the body provided with moveable bands like the recent ones, and teeth of a compressed form, and irregularly fluted; two species are distinguished.

C. Humboldtii. *C. giganteum.*

Heterodon, Lund.

Distinguished by the unequal sizes of the teeth: the fragment of

the lower jaw figured contains six teeth, of which two are much larger than the others.

H. diversidens.

Euryodon, Lund.

Dr. Lund figures a tooth resembling those of the Armadilloes, but apparently broader in proportion to its antero-posterior diameter.

E. latidens.

Glyptodon, Owen.

Carapace ovoid, without distinction of shields or bands, composed of small hexagonal pieces with sculptured surfaces; teeth divided into narrow transverse lobes; malar bone with a lengthened descending process, placed transversely; zygoma flat, its glenoid surface elevated, transversely elongate, looking a little backwards; mastoid proportionally small, placed laterally.

G. clavipes.

The central tubercle upon each ossicle large, round, or subhexagonal, conspicuous above the surrounding ones, which are small, and more cut up by reticulate depressions.

G. ornatus.

The central tubercle of each ossicle not conspicuously marked above the rest; all more finely granular.

This may possibly be the young of that to which the name *reticulatus* has been applied, and which, therefore, I will at present omit.

G. tuberculatus.

Ossicles approaching to a square or rhomboidal form, their surface divided into numerous irregular elevations.

The genus *Hoplophorus* of Dr. Lund appears to be identical with *Glyptodon*; he figures two teeth in which the characters of that genus are clearly shown, and several detached ossicles and portions of carapace bearing a general resemblance to the species of *Glyptodon*, principally to the *G. ornatus*. He distinguishes two species, the *H. Euphractus* and *H. Selloi*. Prof. Owen refers to the *H. Euphractus* a portion of carapace brought home by Mr. Darwin, and figured in the 'Voyage of the Beagle,' which very closely resembles those afterwards figured in the 'Catalogue of Fossil Mammalia and Aves in the Museum of the Royal College of Surgeons' under the name *G. ornatus*.

I am not as yet acquainted with the *Pachytherium magnum* of Dr. Lund's catalogues.

Fam. 3. Myrmecophagidæ.

The nasal bones simple, of uniform width, emarginated at the ends; the intermaxillary bones much reduced; the maxillary bones much lengthened, toothless, the malar process projecting backwards, outwards and downwards; the posterior palatine foramen single, or wanting; the malar bone reduced to a slender stylet free at the pos-

terior end; the foramen rotundum included in the foramen sphenoorbitarium; the zygoma very small, and pushed quite to the anterior superior angle of the squamous portion; the supra-occipital bone encroaches upon the upper surface of the skull, and has a median protuberance; the lower jaw much lengthened and slender at the end, without coronoid process.

Not having seen the skull of the little Two-toed Ant-eater, I have used a little caution in characterizing this family. For example, I have avoided alluding to the peculiar character of the pterygoids, as Cuvier informs us that they do not enclose a long canal as in the larger species. I therefore limit the diagnoses of the genera to the few points, in which, in the absence of a skull of the small species, they are known to differ*.

MYRMECOPHAGA, Linnæus.

Fore-feet with four toes; hind-feet with five toes; palatine and pterygoid bones united beneath the nasal canal for their whole length.

M. JUBATA, Linn.

Varied with black and grey, the latter predominating on the head, back, sides, fore-limbs and tail; throat, a mark running obliquely from the shoulder upwards and backwards, and hind-limbs black; fur very coarse; tail but little longer than the body, very bushy.

M. TAMANDUA.

Head, shoulders, fore-limbs, outside of the hind-limbs, and middle third of the tail white; a stripe from each side of the neck over the shoulder and remaining parts black; tail but little longer than the body, its terminal third scaly. Varies chiefly by the diminution of the intensity of the black.

I have found that the Yellow Ant-eater, hitherto considered to be one of the varieties of this species, differs remarkably in the length and size of the tail; the ears also appear to be larger, but this latter character is less decisive, owing to the different degrees to which they may shrink when dry. A specimen in the British Museum, and one in that of this Society, resemble each other exactly, while a young pale specimen of *M. Tamandua* has a tail proportionally of the same length as the larger and darker individuals. Under these circumstances I have been induced to propose a name for the Yellow Ant-eater, deeming it probable that the species may be distinct.

M. LONGICAUDATA.

General colour uniform light ochraceous, a paler line runs down the middle of the back; tail nearly double the length of the body, its terminal half covered with small scales and a few scattered black hairs; ears large, round, about one-third the length of the head.

* I have since seen the cranial portion of the skull of the Little Ant-eater, and find that although the pterygoid bones do not enclose the nasal canal below, they s emble those of the larger species in their great extent backwards.

Although the flanks show a slightly darker reflection in certain directions of the light, there is no trace of the mark which runs across the shoulder.

On referring to the figure, in Krusenstern's Voyage (tab. 6 *e*), on which M. Desmarest founded his *Myrmecophaga annulata*, I find it to be a very excellent representation of a Coati-mondi, probably the brown species. The head is bent downwards, the tongue protruded, and curved beneath the left fore-foot; from under the further side of the foot there comes a small twig of a tree, which, if it were not branched, would look like a continuation of the tongue. But the figure published in Griffith's translation of the 'Règne Animal' is not so easy to interpret. The general form of the body is more like that of an Ant-eater, though rather too long and slender; the tapering head and the dark stripe from the end of the muzzle to the eye remind one of the *Myrmecobius*, which was not known until several years afterwards; the tail is just such as a Coati-mondi might have supplied. The figure is said to have been drawn from a stuffed specimen, but the authors do not state where the specimen existed, and possibly may never have seen it.

Cuvier asserts, with much probability, that the animal from which Buffon took his figure of the *Tamandua* was made up of the skin of a Coati-mondi, to which striped markings had been artificially applied.

Cyclothurus, Gray.

Fore-feet with two toes, the outer one much the larger; "the palatines only meet below for two-thirds of their length, and the bony canal of the nares there terminates, the pterygoids not meeting, but presenting only two long parallel and little prominent crests."

C. didactylus.

Dr. Lund inserts in his lists of fossil species one which he has named *Myrmecophaga gigantea*, but I have seen no representation of any portion of the animal among the figures published.

Fam. 4. Manidæ.

The intermaxillary bones small, having ascending processes running upwards and backwards; each encloses a separate incisive foramen; the maxillary bones short, toothless, their malar processes projecting backwards, outwards and downwards; the palatine bones much spread out in front, and with distinct posterior palatine foramina; the malar and lacrymal bones wanting, but a large lacrymal opening; the alisphenoid bone much reduced; the zygoma deep, thin, concave exteriorly, and pushed downwards to the anterior and inferior angle of the squamous portion; the occipital condyles prominent, oblique, the precondyloid foramina at some distance anterior to them.

This family consists of but one genus, containing several well-marked species.

Manis, Linnæus.

In characterizing the species of this genus, I give the number of scales in each transverse row, instead of the number of longitudinal

rows, which has been the usual method adopted. The number in each case will appear much less, but it will be recollected that this is owing to the scales of one row being alternate with those of the next one.

M. PENTADACTYLA, Linn. (*macroura*, Desm.)

Each transverse row of scales composed of three on each side of the median one; scales striated at the base, smooth at the end, the striated part distinctly separated from the smooth portion; ends of the scales simple; under parts naked; tail very broad at the base, about equal to the body in length; fore-feet five-toed, the claw of the medius much the largest, that of the annularis next, that of the index much less, the other two very small; hind-feet with lengthened claws; limbs scaled to the bases of the claws.

M. JAVANICA, Desm.

Four scales on each side of the median one in each transverse row, the lower ones on each side, and the lateral ones beneath the tail, keeled and pointed at the ends; tail broad at the base, equalling the head and body in length; under parts with short white hairs; limbs scaled to the bases of the claws; fore-feet with the middle claw largest, the index a little less than the annularis, the others very small; hind-feet with lengthened claws.

M. TEMMINCKII, Smutz.

Body altogether very broad; scales broad, three on each side in every transverse row, striated to the tips which are rounded, none of them carinate; under parts naked; tail about the length of the body, broad and rounded at the end; limbs scaled to the bases of the claws; fore-feet with the middle claw largest, the two next less, the remaining two much less; those of the hind-feet vertical, truncated.

M. TETRADACTYLA, Linn. (*Africana*, Desm.)

Scales large, three on each side in every transverse row, striated to the tip, which is square, with a point projecting from the middle, the lower ones at the sides and the lateral ones beneath the tail carinate; tail double the length of the body, a little narrowed at the base, soon becoming broad; limbs only scaled at the base, then covered with black hairs like the under parts; fore-feet with the middle claw very long and compressed, the index and annularis much less and nearly equal, the minimus less still, the inner toe very small; hind-feet with lengthened claws, nearly equal.

M. MULTISCUTATA, Gray, Proc. Z. S. Feb. 1843.

Five scales on each side of the median one in every transverse row; scales striated to the tip, which is square, with a median point; those on the sides of the trunk and limbs, and the lateral ones beneath the tail, carinate; tail nearly double the length of the body, of moderate width; under parts with short whitish brown hairs; fore-

limbs scaled to the carpus; toes all well-developed, except the thumb, which is small, the medius longest; hind-feet scaled nearly to the base of the claws, which are all lengthened and well-developed, except the thumb, which is small; the annularis nearly as long as the medius.

M. aurita, Hodgson.

Fam. 5. Orycteropodidæ.

The nasal bones long and much spread out behind, narrowed and not projecting anteriorly; the intermaxillaries well-developed, prominent below, not enclosing foramina; the maxillary bones lengthened and deep, provided with compound teeth; the palate terminating soon with a strong transverse ridge, having a pair of large posterior palatine foramina; the lacrymal bone large, extending much upon the face; the malar bone large, extending much upon the face, but its zygomatic process small and slender; the frontal bone large and swollen, with a small and contracted post-orbital process; the parietals extended downwards at their anterior inferior angles to articulate with the alisphenoids; the zygoma slender, twisted as in the Armadilloes; a strong post-articular and a post-auditory process, and just within the latter a short truncate styloid process, not enclosed by any vaginal process, as the tympanic bone is much reduced and separate; the occipital condyles hemicylindrical, but with a portion of articular surface continued from them upon the lower edge of the foramen magnum; the paroccipital processes in a line with them, but distinctly separated.

As this family consists, so far as is yet satisfactorily known, of a single species, its characters might be multiplied to almost any extent; should another form be discovered, they will of course need revision.

This communication having extended far beyond the length that I at first contemplated, notwithstanding that I have limited myself in most cases to the distinctive peculiarities of the skull, it will readily be seen that, had I entered upon the whole osteology of the order, or even introduced in every instance the characters by which the genus or species may be known externally, I should have swelled this little monograph to such a degree as almost to preclude its insertion in the 'Proceedings' of the Society, and entailed upon myself an amount of labour from which I would by no means shrink, but fear I shall be compelled to defer until more favourable opportunities present themselves; but I trust that the little I have as yet accomplished may afford the naturalist a clearer insight into the relations of the living Edentata among themselves, and with those that formerly peopled the portion of the world which was then, as now, the principal abode of this remarkable group.

Pimlico, July 1851.

MISCELLANEOUS.

SPADIX PURPUREA, GOSSE.

To the Editors of the Annals of Natural History.

Falmouth, September 30, 1853.

GENTLEMEN, — The *Spadix purpurea*, Gosse (*Arum Cocksii*, Vigurs; *vide* Report of the Royal Polytechnic Society, 1849) is an old friend of mine, having found it in the autumn of 1844, attached to the under surface of a large stone, extreme low water mark, spring tide, Gwyllyn-vase, in the neighbourhood. Since that period a great number of specimens have been sent to some of the first-class naturalists of the age, in this country, on the continent, and in America, but hitherto it has proved an enigma not easily solved. In the year 1847 Mr. J. Alder sent several from Falmouth to the Members of the Natural-History Section, British Association, and specimens alive were forwarded, per post, to Sir G. Dalyell, but unfortunately death terminated the career of this good and great man before he had time to untie the Gordian knot. I am glad that another habitat has been found for this interesting creature. I have repeatedly produced the young from the ova; they are free for several days, and perambulate on their stilt-like legs with ease and agility.

I am, Gentlemen, your obedient servant,

W. P. COCKS.

Note on the Parasitism of Comandra umbellata, *Nutt.*

By ASA GRAY.

So long ago as the year 1847, Mr. William Mitten, an English botanist, communicated to Hooker's London Journal of Botany (vol. vi. p. 146. pl. 4) a brief article, on the œconomy of the roots of *Thesium linophyllum*; in which he shows that the roots of this plant are parasitic; the ramifications of the root forming attachments, by means of suckers, with the roots of adjacent plants of various species. The same parasitism probably occurs in other species of *Thesium*, if not in the genus generally. But I am not aware that the fact has been confirmed on the continental species, which are somewhat numerous, although attention has been called to the subject by the reprint of Mr. Mitten's article in the 'Annales des Sciences Naturelles' (in the volume which bears the nominal date of 1847), and an interesting extension was at once given to the discovery by M. Decaisne, who detected a similar parasitic attachment of the rootlets of *Melampyrum*, *Pedicularis*, and other rhinanthaceous plants long known to be uncultivable.

In the Botanical Text-book, I had called attention to the related genus *Comandra*, which replaces *Thesium* in this country, as likely to exhibit the same parasitic œconomy, but, pressed by other occupations, had neglected to make the examination myself; nor had I any notice of the observation having been made by others, although *Comandra umbellata* is everywhere a common plant in the United States.

The discovery, however, has now been made by my esteemed correspondent, Mr. Jacob Stauffer, of Mount Joy, Lancaster County, Pennsylvania. He has recently sent me fresh specimens of *Comandra umbellata*, with its elongated and woody subterranean stems, giving off numerous roots, the branches of which are often expanded at their tips into a small tubercle or sucker, which is implanted by its disc-like surface upon the bark of adjacent roots, principally of shrubs. The foster-plants, in the specimens communicated, are Blueberries and Huckleberries (*Vaccinium vacillans* and *Gaylussacia resinosa*). Mr. Stauffer's specimens are accompanied by a neat drawing, illustrating the mode of attachment. This I would gladly forward for the engraver: but it will suffice, perhaps, for the present to say, that the attachment is similar to that so clearly exhibited by Mr. Mitten, in the plate which accompanies his article; only that the rootlets in *Comandra* arise from subterranean stems, and the suckers, so far as I have examined, do not appear to penetrate the foster-root deeper than the surface of its wood.

Since the above was written and in type, I have received from Mr. Stauffer the announcement of his discovery of the parasitism of *Gerardia flava*, accompanied by a drawing which exhibits it, and a specimen which plainly shows the attachment. The numerous branches of the root are not only attached by discs or suckers to the bark of the root of the foster-plant (in this case either white oak or witch hazel), but also are implanted upon each other, forming parasitical anastomoses.—*Silliman's Journal*, Sept. 1853.

RARE IRISH MOLLUSCA.

To the Editors of the Annals of Natural History.

Windsor Lodge, Monkstown, co. Dublin,
September 30, 1853.

Gentlemen,—Having had a few days' dredging last month off this coast, will you kindly record for me, at your earliest convenience, the obtaining of the following Mollusca? Those species marked with an asterisk I believe to be new to the fauna of this county.

**Corbula rosea.* Off Dublin Bay.
Lyonsia Norvegica. Killiney Bay and Dalkey Sound.
**Thracia distorta.* Dalkey Sound.
Cochlodesma prætenue. Killiney Bay and Dalkey Sound.
Solecurtis coarctatus. Same localities as the last species.
**Astarte elliptica.* Dalkey Sound.
—— *sulcata*, var. *Scotica.* Same locality as the last species.
**Lepton squamosum.* Dalkey Sound and Killiney Bay.
**Nucula radiata.* Dalkey Sound.
* —— *tenuis.* Same locality.
Leda caudata. Killiney Bay and Dalkey Sound.
Trophon Barvicensis. Dalkey Sound.
Mangelia septangularis. Same locality.
Phyline scabra. Same locality.

I am, Gentlemen, yours obediently,
William White Walpole.

NATICA SORDIDA.

To the Editors of the Annals of Natural History.

Windsor Lodge, Monkstown, Co. Dublin,
Oct. 22, 1853.

Gentlemen,—I have much pleasure in being able to record another habitat for that rare Mollusk *Natica sordida*, specimens of which were obtained by me this summer; they were taken off this coast by trawling in about sixty fathoms. In company with the above shell was found *Fusus propinquus*; I have also noticed the same two Mollusca occurring together off the Wexford coast, and my friend Dr. Melville has likewise dredged the two species in close proximity off the Isles of Arran, Galway Bay.

I remain, Gentlemen, yours truly obliged,
William White Walpole.

METEOROLOGICAL OBSERVATIONS FOR SEPT. 1853.

Chiswick.—September 1. Cloudy and fine: heavy rain. 2. Overcast: heavy rain. 3. Clear. 4. Cloudy and fine: very fine: overcast. 5. Fine: cloudy: clear. 6. Very fine: clear at night. 7, 8. Overcast. 9. Foggy: rain. 10. Fine: slight rain. 11. Fine. 12. Cloudy and fine. 13. Rain: fine: clear. 14. Dense fog: very fine. 15. Foggy: cloudy: rain at night. 16. Uniform haze: showery. 17. Very fine. 18. Slight fog: very fine. 19, 20. Very fine. 21. Foggy: fine. 22. Very fine: rain. 23. Cloudy. 24. Clear: cloudy: clear: lightning in the evening: rain. 25. Rain: boisterous throughout. 26. Clear and windy. 27. Slight fog: fine. 28. Overcast. 29. Fine: rain. 30. Very fine: clear: lightning, with rain at night.

Mean temperature of the month	55°·45
Mean temperature of Sept. 1852	56 ·21
Mean temperature of Sept. for the last twenty-seven years	57 ·04
Average amount of rain in Sept.	2·57 inches.

Boston.—Sept. 1. Rain A.M.: lightning P.M. 2. Rain A.M. and P.M. 3. Fine. 4. Cloudy. 5, 6. Fine. 7—10. Cloudy. 11. Fine. 12. Cloudy. 13. Cloudy: rain A.M. 14. Fine. 15. Cloudy: rain A.M. 16. Fine: rain P.M. 17, 18. Cloudy. 19, 20. Fine. 21. Cloudy. 22. Fine. 23. Cloudy. 24. Fine: rain A.M. 25. Rain A.M. and P.M.: very stormy P.M. 26. Fine: very stormy A.M. and P.M. 27—29. Cloudy. 30. Fine.

Sandwick Manse, Orkney.—Sept. 1. Bright A.M.: clear P.M. 2, 3. Cloudy A.M.: cloudy, aurora P.M. 4. Clear, fine A.M.: clear, aurora P.M. 5. Clear, fine A.M. and P.M. 6. Clear, fine A.M. and P.M. 7. Damp A.M.: cloudy P.M. 8. Drizzle A.M.: cloudy P.M. 9. Bright A.M.: clear P.M. 10. Bright A.M.: cloudy, aurora P.M. 11. Cloudy A.M. and P.M. 12. Bright A.M.: cloudy P.M. 13. Cloudy A.M.: showers P.M. 14—16. Bright A.M.: cloudy P.M. 17. Cloudy A.M. and P.M. 18. Showers A.M. and P.M. 19. Rain A.M.: damp P.M. 20. Cloudy A.M.: cloudy, showers P.M. 21. Bright A.M.: rain P.M. 22. Rain A.M.: sleet-showers, thunder and lightning P.M. 23. Showers A.M.: sleet-showers, aurora P.M. 24. Bright A.M.: sleet-showers P.M. 25. Cloudy A.M.: sleet-showers P.M. 26. Bright A.M.: sleet-showers P.M. 27. Bright A.M.: showers P.M. 28. Rain A.M.: showers, thunder and lightning P.M. 29. Bright A.M.: cloudy P.M. 30. Showers A.M.: cloudy P.M.

Mean temperature of Sept. for twenty-six previous years	52°·26
Mean temperature of this month	53 ·28
Mean temperature of Sept. 1852	53 ·45
Average quantity of rain in Sept. for thirteen previous years	2·75 inches.

Meteorological Observations made by Mr. Thompson *at the Garden of the Horticultural Society at* Chiswick, *near London*; *by* Mr. Veall, *at* Boston; *and by the* Rev. C. Clouston, *at Sandwick Manse*, Orkney.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston. 8¾ a.m.	Orkney, Sandwick.		Chiswick.		Boston. 8¾ a.m.	Orkney, Sandwick.		Chiswick. 1 p.m.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1853. Sept.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
1.	29·727	29·625	29·28	29·92	29·97	63	51	58	56	51	s.	ese.	n.	·80	·14	·22
2.	29·863	29·710	29·27	30·00	30·09	60	42	52·5	53	51	n.	n.	nw.	·44	·06	.....
● 3.	30·201	30·093	29·66	30·24	30·37	62	49	52	55½	52	n.	nw.	n.	.....	·50	.....
4.	30·318	30·272	29·90	30·44	30·40	65	49	60	56	50	ne.	n.	ese.	.....	.....	.....
5.	30·373	30·304	29·94	30·42	30·43	68	50	58	58	53	ne.	n.	se.	.....	.....	·04
6.	30·280	30·219	29·90	30·37	30·33	68	44	60	57½	55½	ne.	ne.	w.	.....	.....	.....
7.	30·108	30·017	29·73	30·22	30·17	67	43	57	58	55	ne.	ne.	nw.	.....	.....	.....
8.	29·937	29·904	29·55	30·10	30·04	63	47	56·5	57	53	n.	nw.	ne.	.....	.....	.....
9.	29·866	29·753	29·46	29·98	29·93	65	46	58	61	56	se.	calm	se.	·12	.....	.....
☽ 10.	29·818	29·669	29·30	29·91	29·96	67	41	63	63	58	s.	se.	se.	·01	.....	·07
11.	29·961	29·886	29·50	29·90	29·80	73	48	58	63	58	s.	calm	se.	.....	.....	.....
12.	29·996	29·874	29·53	29·80	29·83	70	54	63	63	57½	s.	sse.	ssw.	·03	.....	.....
13.	30·052	29·961	29·47	29·88	29·93	63	45	55	56	52	nw.	nw.	w.	·07	.....	.....
14.	30·081	29·912	29·64	29·94	29·96	70	50	48	57	54	sw.	calm	se.	.....	·12	·06
15.	29·987	29·934	29·57	30·10	30·14	61	55	58	58	55	ne.	calm	calm	·19	.....	.....
16.	29·953	29·916	29·54	30·00	29·93	65	54	60	59	56	n.	se.	nw.	·04	·06	.....
○ 17.	30·063	30·008	29·60	29·91	29·95	69	43	54	58	54	ne.	nnw.	wsw.	.....	.....	.....
18.	30·198	30·100	29·67	29·90	29·98	70	42	59	52	52	nw.	nnw.	sw.	.....	.....	·28
19.	30·244	30·110	29·75	29·67	29·51	70	49	52·5	57	57	sw.	w.	wsw.	.....	.....	·42
20.	30·057	29·931	29·58	29·73	29·75	62	41	50	54½	53	sw.	wsw.	sw.	.....	.....	·01
21.	29·937	29·834	29·46	29·68	29·51	65	44	58	55	54	w.	w.	se.	.....	.....	·19
22.	29·839	29·754	29·34	29·23	29·16	67	54	55	52	45	sw.	sw.	sw.	·08	.....	·11
23.	29·754	29·704	29·26	29·04	29·00	61	41	57	49	47	w.	w.	sw.	.....	.....	·10
24.	29·743	29·687	29·28	29·38	29·38	60	34	50	49	45	w.	w.	w.	·14	.....	·41
☾ 25.	29·330	29·083	28·76	29·14	29·21	64	45	47	46	44	sw.	s.	nnw.	·02	·42	·14
26.	29·810	29·562	29·14	29·53	29·58	57	32	47	46	46	nw.	nw.	w.	.....	·20	·16
27.	29·901	29·894	29·50	29·60	29·52	63	47	47	48½	47	sw.	w.	ssw.	.....	.....	·18
28.	29·892	29·854	29·40	29·03	28·97	66	54	58	55	49	sw.	sw.	w.	·02	.....	·50
29.	29·935	29·835	29·43	29·52	29·57	65	45	55	49	45	sw.	sw.	w.	·25	.....	·39
30.	29·991	29·916	29·50	29·57	29·57	61	38	50	46	44	nw.	w.	s.	·20	.....	·26
Mean.	29·973	29·877	29·47	29·805	29·798	65·00	45·90	55·2	54·93	51·63				2·41	1·50	3·54

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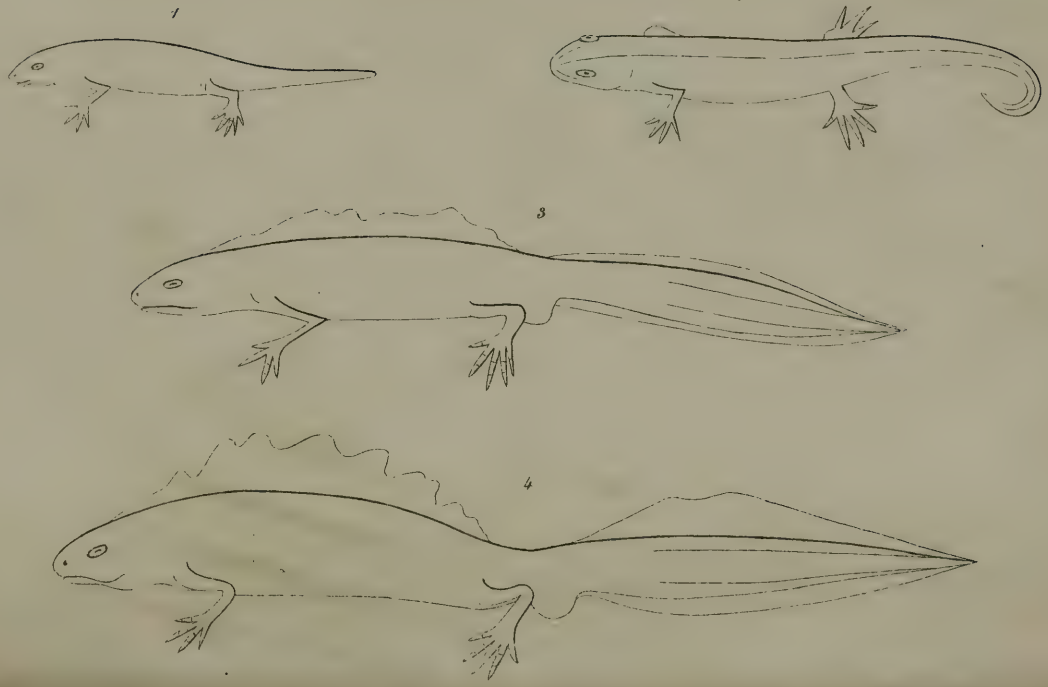

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

No. 72. DECEMBER 1853.

XXXIV.—*On the British* Tritons.

By JOHN HIGGINBOTTOM, F.R.S.

[With two Plates.]

THESE observations are the result of an unremitting attention to the natural history of the *Triton* during five years.

Regarding the physiology of each individual species of animal as a type and example of physiology in general, I imagine that the science would not be advanced more certainly than by an undivided investigation of one, and that a most interesting example.

My steps have been guided by the works of Dr. Rusconi and Professor Bell, and the following observations will be found curtailed or extended, as I imagine I have arrived at the same results as these two authorities have done, or added some new facts or views to what was previously known.

As the result of my observation, I may premise that I have not been able to find more than two species of Triton in the midland counties of England; that these, produced in water, are furnished in a peculiar manner with respiratory organs, first for aquatic respiration, and in the second place for atmospheric respiration; that after leaving the water they chiefly remain inhabitants of the land and breathe atmosphere for no less a period than three years uninterruptedly, passing through changes and states in their slow growth, which have misled naturalists into the opinion that there are more species than really exist; that at the expiration of the third year the animal in its mature state betakes itself for a second time for a season to the water, but solely for the purpose and during the period of reproduction; and that this view of the subject, the result of long and assiduous

observation, is singularly confirmed by the facts of the anatomical structure, viz. that the male Triton has no appearance of crest, silvery stripe on the tail, fringe or membrane on the hind toes, during the first and second year; and the testes and ovaries are of a very diminutive size, facts to be noticed more particularly hereafter.

The principal questions which I purpose to notice are—

1st. The determination of the number of species of Triton in the midland counties of England.

2nd. The fecundation, deposition, and bursting of the ova.

3rd. The development of the Tadpole and the perfect animal.

4th. The uninterrupted extension of its terrestrial life through three whole years in a state of activity in the summer, and in a state of hibernation in the winter season.

5th. The limitation of its second aquatic life to the period required for reproduction.

6th. Certain peculiarities in its anatomy.

I. *On the Species of* Triton.

During my long observation of the *Triton* in the pools of the midland counties and their clayey banks, &c. &c., I have not been able to detect more than two species; one of them is that termed the common warty Triton, and the other is designated the common smooth Triton. But these two species of the Triton present such varied appearances during the three years of their slow but progressive growth, and during the changes they experience preparatory to their return from being inhabitants of the land, breathing atmospheric air, active in the summer and hibernant in the winter, to being active denizens of the water, reproducing their kind in the months of March, April, May, June and July, that I think they have been regarded by naturalists as presenting too great a number of distinct species.

The crest, from which one species has received the designation of *cristatus*, and the fringe or membrane, from which another has received that of *palmipes*, are not permanent adjuncts, but exist only during the active season of reproduction, and only in the male. These appendages are scarcely therefore admissible as characteristics of the species of Triton. I would venture to propose as permanent and descriptive names, which I shall take the liberty of making use of in this paper, the terms *Triton asper* and *Triton lævis*; in fact, the large Triton is at all times distinguished by its rough granular skin, whilst the smaller is always known by its smooth surface.

The terms aquatic and terrestrial are not more applicable, as I am enabled to say, that no species of Triton is exclusively

either terrestrial or aquatic, but that both are equally aquatic in their early tadpole stage and in their later and reproductive life, and equally terrestrial in the long intermediate period.

Cuvier himself observes, in a note subjoined to his description of the various species of Triton:—"Cette caractérisation des espèces européennes est celle qui m'a paru le plus conforme à la nature, mais il me serait très-difficile d'y rapporter exactement la synonymie des auteurs, tant je trouve leurs descriptions et leurs figures peu d'accord avec les objets que j'ai sous les yeux*."

II. *The Fecundation, Deposition, and Bursting of the Ova.*

From minute observations of the process of fecundation in the pools where the Triton abounds, I am led to conclude that this takes place internally through the medium of water, without the immediate contact of the sexes.

The protuberances on each side of the cloaca in the male are very prominent during the breeding season.

The protuberances and the villous enlargement also around the cloaca in the female, exist in this prominent condition only during that period.

The ova begin to be deposited as early as the beginning of April, and continue to be deposited as long as the first or second week in July.

If a plant with long leaves be thrown into a pool where there are Tritons for only a single night during the breeding season, it will be found on the following morning to have a number of its leaves folded, and within each fold an ovum.

For the successful development of the ova, it is necessary generally that they should be deposited and enclosed within the folded leaves of some living aquatic plant. If they are placed at the bottom of a vessel, or merely on the surface of a leaf exposed to the water, they usually perish at an early period.

For this purpose some aquatic plants are much more suited than others, the best being those which have some firmness of fibre. I have seen some ova laid on the water dock, which it has required the little animal to exert very strong pressure to double; this, however, it has effected at length by breaking the firm fibres of the plant.

I have found that some aquatic plants are too pliable and soft, as the *Nasturtium aquaticum*. Not having sufficient fibre to preserve the ova the fold is not permanent, so that the ova become too much and too early exposed to the water, and they perish. The most favourable plants I have observed for the deposition of

* Règne Animal, t. ii. p. 117.

the ova are the *Veronica anagallis*, and the long grasses which abound in some pools.

The *Veronica anagallis* has a firmer leaf than the *Nasturtium aquaticum*, is formed into firmer folds, and is thus better calculated for enclosing and protecting the ova. The long grasses appear still more favourable for this purpose, and are best suited for the security of the ova; they admit of four or five or more of the ova being deposited singly in folds on a single blade. Each ovum is generally placed in the centre of that part of the blade on which it is laid, and is neatly covered within a fold in such various directions as frequently to present a fantastic appearance, when the whole or the greatest part of the blade is folded. Almost any aquatic plant serves as a receptacle of the ova. I have seen them deposited even within the linear leaves of the *Ranunculus aquaticus*, so compressed as to secure the ova.

The Triton, when depositing its ovum, first rests with the lower part of the body across a leaf or blade of grass; this it folds up by means of its posterior extremities, making repeated acts of pressure with them until the fold is sufficiently complete to admit of the secure insertion of the ovum; when that is accomplished the posterior extremities are pressed together upon the enclosed ovum for a minute or more, when the little animal quits it to deposit another ovum. The ovum when first deposited is round and has a small white yolk in its centre, which has no attachment within its envelope, but is surrounded by an aqueous fluid, within a firm transparent capsule.

A soft jelly-like substance covers the surface of this capsule, which materially assists by its adhesive property in securing the ovum and preserving it from too great exposure to the water, an event which at an early period often destroys its vitality, in which case it is seen to become covered with mould. In about a fortnight the ovum becomes so large as in some degree to sever itself from the fold of the leaf, and some parts of the ovum now come freely in contact with the water without injury; indeed, the free exposure to the water appears necessary for its further development. By the experiment of putting some ova into water coloured with saffron for a short time, it will be found that they exhibit an appearance of little golden balls, and by removing them afterward into clear water for a time, they become colourless, proving that there is a constant endosmose and exosmose through each ovum, so that there is a constant supply of fresh water for the preservation and further development of the embryo.

The safety of the ovum depends also, at an early period of its development, upon the integrity of the leaf on which it is deposited, as I have already stated, for when this is much broken in folding, when the plant is too delicate of fibre, or from other

causes, the ovum becomes exposed to the water too early and perishes.

About a week after the ovum has been deposited, the embryo acquires more of an oval shape; in another week it increases in size, and the head, body and caudal extremity are seen distinctly through the transparent capsule which gradually increases in size; in about three weeks the embryo is perfect and beautifully formed, and moves quickly round within its envelope, which is now much distended.

About this period the tadpole escapes from the capsule, when in water freely exposed to the open air, but its development is modified by circumstances, such as situation, temperature, &c.

I kept some ova in a room with a south aspect at 60° Fahr., and the tadpoles escaped in fourteen days. I placed other ova, which were deposited on blades of grass, in a deep, dark, rock cellar, at 48° Fahr.; they were fully developed in these in three weeks, the same time as some others placed in the open air at 55° Fahr.; but after quitting the ova, the growth of those tadpoles in the cellar was materially impeded; the facts of which are given in my paper "On the Influence of Physical Agents on the development of the Triton and Frog," published in the Philosophical Transactions, Part 2, for 1850, p. 431.

III. *The Development of the Tadpole and the young Animal.*

At length the ovum bursts, and the tadpole escapes and swims freely away; it rests or suspends itself on the edge of a leaf, or on a blade of grass, or on the oblique sides of the vessel. It sometimes remains on the bottom of the vessel, lying on one side, as if inanimate or unable to sustain itself, but on being disturbed it quickly swims away.

Shortly after the tadpole quits the ovum it feeds voraciously on aquatic larvæ, animalculæ and small animals in the water. I have seen the *Triton asper* in its branchial state with three of the smaller species in its stomach at one time. The Triton remains in the water in the tadpole or fish-like state until its branchiæ disappear and its legs become sufficiently strong to enable it to quit this element. The development and growth of the legs is very tardy; the anterior extremities are about twenty-one days in being formed after quitting the ovum; the posterior about ninety days, and they are then extremely fine and delicate; but as the legs become stronger, the branchiæ gradually disappear and the opercula close over the gills. When these changes are accomplished, the animal leaves the water and becomes entirely terrestrial. This occurs generally in September, between the first and last week in that month; but to this rule there is an exception, which I first observed in October 1845, on examining some pools where Tritons of both species abound

during the summer season. I found a *Triton asper* in the tadpole state, with large branchiæ and an expanded tail. I kept it in a glass globe in the open air in water (in which were aquatic plants) during the winter months, and found that it retained the branchiæ until the succeeding February, when it died. The following month (March) I had brought to me two tadpoles of the smooth species in the same condition, with the persistent branchiæ and expanded tail, and on searching a pool where this species particularly abounds I found several others. I perceived that these could not be of that season's growth, for at this period the full-grown Tritons had not come to the water, the breeding season not having commenced. I considered that these tadpoles must be the produce of the ova deposited late in the former season, as in June or July; and this view I think was corroborated by their branchiæ disappearing in June, nearly three months earlier than in those produced from the ova deposited in the spring. These observations appear to prove that the Triton does not grow during the winter, and that in genial weather, between five and six months are required for the tadpole to arrive at its full development.

IV. *The uninterrupted extension of terrestrial life through three whole years, in a state of activity in the summer and in a state of hibernation during the winter season.*

I think the young generally travel a greater distance from the water than the older ones, and do not, like them, assemble and become coiled together. They are often found in damp cellars, old wells and similar places, and under flat stones, and sometimes deep in the earth, single, and far remote from any pools or water. It is from this circumstance I imagine, and from their long continuance out of water, that in Britain a terrestrial species of Triton has been supposed to exist by some naturalists, and is often called by the common people *the ground newt.* The Triton does not commonly return to the water until the expiration of the third year, when they are so far advanced towards maturity as to be able to reproduce their kind.

It was not until the third year of my investigations that I could account for the different sizes of the Triton existing at the same period of time. At the end of March I found several of the *Triton asper* in holes under the embankment of a pool, the least of them not quite 2 inches in length; and a few days afterwards, that is, in the first week of April, I took out of the water the full-grown Triton nearly 6 inches in length and beautifully crested. On carefully comparing those of the smaller size with some which I had kept during the winter, I perceived that they corresponded with those of one year's growth. On examining and comparing others, I found that there were two

intermediate sizes, so that I was led to the conclusion that the full-grown Triton of three years' growth is partially crested, and that the fully-crested Triton is four years in arriving at this perfect size and state: growth is arrested during hibernation.

During two years of repeated visits to the pools, I did not observe a Triton of the first and second year's growth in the water. During the third year I found none of the first year's growth, and only two of the second year's in the water; the appearance of these I was compelled to look upon as accidental. It seems probable that if the Triton of one year's growth should find its way into the water, it would presently fall a prey to the larger ones, which are very voracious during the breeding season.

The *Triton asper* at the close of one year is about 2 inches in length; the colour of the body is of a blackish brown, slightly rough, with minute spots of white, the breast and abdomen being of a light yellow, sometimes with small dark spots (Pl. XV. fig. 1.)

At the close of the second year this Triton is now more than 3 inches in length, varying little from that of the first year, except in having more dark spots on the abdomen, and sometimes a yellow line extending along the middle of the back to the tail: the sexes are scarcely to be distinguished externally (fig. 2).

At the end of the third year it is 4 inches in length, the skin on the body has become rougher, the breast and abdomen more of an orange colour, and marked with large irregular spots. In the male, during the breeding season and for the first time, there is an indented dorsal crest, and a dark-coloured protuberance on each side the cloaca is observed. The tail (which during the two former years, when terrestrial, was more compressed) becomes now more expanded, and is marked on each side with a silvery stripe, which is persistent. In the female there is an oval raised villous appearance round the cloaca, and the tail is also more expanded (fig. 3).

At the expiration of the fourth year the *Triton asper* is between 5 and 6 inches in length, and the chest and abdomen are of a still deeper orange colour, and marked with dark irregular spots; the male has its full-grown dorsal crest, the tail is still more expanded and of a lanceolate form; and in the female, the protuberances on the sides of the cloaca are larger, and the raised villous appearance is still more apparent than before. The female is usually larger in size than the male (fig. 4).

The generic characters of some Tritons have been distinguished by the upper lip overhanging the lower. I have observed, that in the first year's *Triton asper* the upper lip overhangs the under considerably at the sides. In the second year it overhangs less. Between the second and third year it becomes straighter, and in the fourth it overhangs again as much as in the first year. This

is also very evident in the *Triton lævis*, in which the same changes take place.

In winter the full-grown Triton is often found in the immediate neighbourhood of those pools to which they resort in the spring.

The average weight and length of the *Triton asper* as taken from eighty in number, found in the crevices and holes in the neighbourhood of the pools in September 1846, are as follows:—

First Year's Triton.

LARGEST.	SMALLEST.	AVERAGE.
30 grains.	20 grains.	25 grains.
$2\frac{1}{2}$ inches.	$1\frac{5}{4}$ inch.	$2\frac{1}{6}$ inches.

Second Year's Triton.

70 grains.	46 grains.	54 grains.
4 inches.	$3\frac{1}{4}$ inches.	$3\frac{1}{2}$ inches.

Third Year's Triton.

90 grains.	60 grains.	75 grains.
$4\frac{3}{4}$ inches.	$3\frac{1}{2}$ inches.	4 inches.

Fourth Year's Triton.

180 grains.	120 grains.	134 grains.
6 inches.	$4\frac{3}{4}$ inches.	$5\frac{1}{4}$ inches.

(See Plate XV. figs. 1, 2, 3, 4.)

A similar computation might be made of the *Triton lævis*.

There is a general meeting *of all ages* of the Triton in August and September, before the period of hibernation. It would be useless to attempt to find them at any other time of the year.

In the summer the Tritons of both species are found in abundance in the pools of old brick-yards. The brickmakers, who are constantly disturbing the water and removing the clay, and who occasionally clear the bottoms of the pools, state, that they never find any Tritons in the water during the winter months, but they discover great numbers of them in holes in the clay, and sometimes ten or twelve coiled together.

I have already stated that I have not been able to find any in the pools during the winter, except the branchiated ones beforementioned. To test the accuracy of the opinion and to obtain further knowledge of the habits of the animal, I made the two following experiments:—First I procured a large earthenware vessel (a foot-bath) eight inches in depth, in one part of which I placed pieces of dry clay and some flat stones to the height of six inches, whilst on the other side I placed some moist clay and poured water upon it to the depth of two inches, and thus

arranged a watery and an earthy place of abode for my Tritons. I put a number of these into the water. In a short space of time they all left it and crept into the crevices above and under the stones, and there remained in a state of hibernation during the whole of the winter. About a fortnight afterwards (on the 23rd of October, 1843), I tried a second experiment which I thought would be still more conclusive:—I obtained a large long cylindrical glass vessel; in the centre and at the lowest part of this I secured a piece of pumice-stone with common cement; around the base of the stone I put some soft clay and poured in rain-water to the depth of three inches, leaving the upper part of the pumice-stone uncovered. About three inches above the water I arranged pieces of wood across each other in the form of latticework, supporting it by small wooden pillars, and leaving holes large enough for the animals to creep through, and I placed an inclined plane of wood with notches so as readily to allow them to ascend to the latticework if so disposed. I put twenty Tritons into the water below, and placed clay and some irregular flattened stones upon the latticework to the height of six inches. The top of the vessel was secured by means of muslin. The Tritons found their way in a few hours from the water through the latticework into the crevices and holes formed by the clay and stones; two indeed more bulky than the rest were some time in attaining this object, but these succeeded ultimately. They remained in this situation of comparative dryness during the whole winter, except that one or two occasionally dropped through a crevice into the water. On one occasion, about Christmas 1843, the sun had during two or three days considerable power, and in the afternoon of the 24th December I observed two bats flying about some old buildings in a neighbouring village. On the same day I observed that the Tritons in the glass were restless, and that several of them descended and bathed their tails in the water, but I did not see them go into it; they soon regained their former situation, where they remained in a state of hibernation till the following spring. I have observed that either a very wet or very dry situation is fatal to the Triton during its state of hibernation, and that a moderately damp one is always chosen for that state of existence.

In the autumn of 1843 a considerable number of Tritons escaped during several *wet* days, from two large earthenware vessels which I had placed in a garden upwards of thirty yards from my house; some of these were found in an adjoining garden, but several months afterwards, on the 2nd of December, eleven (nine of the *Triton asper*, and two of the *Triton lævis*) were discovered coiled together behind and under a broken brick at the further end of a deep rock cellar. They had thus found

their way through a grating which led to the cellar in an irregular course twenty-six feet deep and nearly perpendicular.

The cellar was sufficiently damp to prevent evaporation and to continue the cuticular absorption, for they were all plump and healthy; but having been afterwards put into a small white glazed jar and left in a room from 55° to 60° Fahr. and forgotten, they were found dead in a desiccated state after the lapse of three or four days.

Another accident occurred to a number of the Tritons which I had kept exposed to the weather in a large vessel with clay and stones. There had been a continued rain for several days, and they had from this cause become covered with water whilst in a state of hibernation. I found them all dead and swollen, whilst others which had not been exposed to the rain were in a healthy state.

I have, in two experiments, found that the Triton can live in a solid mass of ice, without injury, as has been noticed by naturalists.

In Feb. 1844 I put two Tritons into some water in a vessel and exposed them to a freezing temperature during the night; in the morning I found the water frozen very firmly, with the Tritons enclosed in its centre. On thawing they were lively and flexible; not in the same condition which occurs during hibernation, for when in that state I have found them comparatively stiff, with the body bent in various shapes, and with the tail partly curved, and on being put into the hand (at 80° Fahr.) they twist the body, and the tail becomes more curved.

In the second experiment there was a piece of ice at the bottom of a circular vessel. I placed two Tritons upon it and then another covering of ice, and filled the vessel with water. I exposed it during the night in the open air at the temperature of 28° Fahr. In the morning the whole had become a solid mass of ice, twelve inches in circumference, with the animals in the centre.

On breaking the ice carefully they were found completely encased in the ice. I had some difficulty in separating one extremity, but being liberated it used its arms and legs equally well.

V. *Limitation of its second aquatic life to the period required for reproduction.*

About the last week in March the perfect Triton leaves the land and again becomes aquatic. It has then acquired all those appearances which exist only during the breeding season.

The mode of fecundation in the *Triton asper*, from my own observation, accords with that of Dr. Rusconi, in his work en-

titled 'Les amours des Salamandres.' I will however add a very succinct account from my own observation.

I believe fecundation takes place in the Triton internally, although effected without immediate contact of the sexes. The male pursues the female with perseverance until the latter stops; he then remains with his head inclining to the head of his mate and commences waving his tail for a minute or two, and at intervals with a quicker motion. He then turns upon his side, sometimes with the tail quite erect for a few seconds; these motions are continued for several minutes; when he makes a smart motion with his tail similar to the smack of a whip in a direction towards the female, but without immediate or actual contact; the male then swims away, but the female remains stationary for a short time and then goes away in another direction.

The male *Triton lævis* differs somewhat from the *Triton asper* in the process of fecundation; his tail is bent forwards in the middle and remains in that position, whilst the end has an exceeding quick vibratory motion, the female remaining still by his side.

The full-grown Triton feeds on live aquatic animals, which it is capable of swallowing whole, and the power of retaining the prey when once seized is remarkable. I have often seen a Triton seize on the end of the delicate tail of the tadpole of the frog, and with that slight hold it has drawn the whole body of the tadpole into its gorge. The Triton also feeds upon the *Limneus peregeri* and other mollusca, and it is not uncommon to observe in the stomach and intestines from ten to twelve of these mollusca of different sizes. These distend the intestines, near the lower part of which the shells are found nearly empty. When voided some of the shells are observed to be broken, others are entire, but quite empty. Some of the *Triton asper* I found in the pools late in the season were quite gorged with the young of the smooth species, and I have seen them devour the young of their own.

The digestive power of the Triton, when inhabiting the water, is very great, for in three days after it has been gorged with the tadpole of the frog, the stomach and intestines are found nearly empty.

On the other hand, some Tritons which I kept from September to March without food, after being in a state of hibernation in a damp situation for so many months, did not appear emaciated.

About the first or second week in July, the crest and the other peculiarities which they had acquired preparatory to the breeding season disappear both in the male and female; this process of absorption takes place rapidly, and afterwards they are no longer induced to remain in the water; so that early in the month

of August there is a visible diminution of the number in that element. I have seen some as late as the middle of August, and but rarely in the beginning of September.

In the middle of August I have procured a number of both species from crevices and embankments, whither they have retired until the next breeding season.

VI. *Peculiarities in the Anatomy of the Triton.*

In the tadpole state the Triton is furnished with no less than four distinct organs for respiration: 1st, the gills; 2nd, the branchial fringes; 3rd, the lungs; 4th, the cutaneous surface and expanded tail and crests.

The gills form three perfectly distinct semilunar arches immediately beneath the operculum on each side.

The branchial fringes extend and float externally so as to admit of the circulation being readily observed under the microscope, and each loop is continued along one of the semicircles of the gills.

In addition to these forms of respiratory organs, the lungs are visible on opening the general thoracico-abdominal cavity. These contain air from their earliest period. It is obvious that the lung will answer the purpose of the air-bladder in fishes. I have repeatedly observed that the tadpole is at one time of rather less specific gravity than water, rising to and remaining at the surface without effort, and at other times of rather greater specific gravity than that fluid, falling to the bottom of the vessel in the same manner.

I scarcely need make any observation on the cutaneous surface as a respiratory organ.

The blood circulating in the expanded tail and crests is almost as much exposed to the respiratory medium as that in the branchial fringes themselves.

As the period for quitting the water approaches, the branchial fringes disappear and the opercula closely adhere over the gills, which also disappear in their turn.

The other peculiarities of the anatomy of the Triton relate to its resumption of the water, and to its new function of reproduction at the spring of the fourth and subsequent years. The crest in both species of the Triton, and the fringe or membrane in the posterior extremities of the *Triton lævis*, undergo a rapid development in the months of February and March. They are obviously destined to enable the animal to move about rapidly in its native element and assist in aquatic respiration (Pl. XVI. fig. 5).

In the month of June these adjuncts begin to disappear, and by the middle of July the crest, &c. remain only in the form of mere ridges (Pl. XVI. figs. 6 & 7).

In all other ages and periods the crest and the fringe or membrane are absent, affording a perfect proof that the observations which have been made respecting the protracted terrestrial life of these animals are correct. No Tritons of the sizes denoting the different ages between the tadpole state and the completion of the third year possess either crest, fringe or membrane, or silvery stripe along the tail, as observed in the male.

But the most striking point of the anatomy of the Triton is that which I proceed to notice; there is not, until the completion of the third year, a full development of the testes in the male, or the ovaria in the female.

The Triton, from the first appearance in the tadpole state to the completion of the second year, has no external appearance of sex, except in the male a slight dark appearance in the situation of the cloaca, which requires minute observation; and internally the testes and ovaries are of a very diminutive size, the testes being not much larger than a coriander seed in the second year, and the ova bags but just discernible.

From the second to the third year all the signs of the male and female are rapidly developed, and they are matured at the lapse of three years, just at the period when the animal returns, as I have stated, to its pristine element.

I may here state, that during the winter when the Triton is in a state of hibernation, both the lungs and stomach are frequently found empty.

The cutaneous surface is sufficient for the low degree of respiration required in this state, and the processes of digestion, assimilation, &c. are equally in their lowest degree, and are in accordance with a general law.

Like some other hibernating animals, the Tritons of the third and fourth year are found during the cold season in the earth under stones, in clusters of the magnitude of a cricket ball.

Those of an earlier period are often found singly at a greater depth under the earth as before stated.

Observations on a new species of British Triton.

In April 1848 Dr. Buckland, Dean of Westminster, informed me of a new species of *Triton*, and referred me to Mr. Baker of Bridgewater for information.

On writing to that gentleman he very kindly sent me some specimens, and in July following directed my attention to a paper on the subject in the 'Zoologist' (Zool. 2149) by Mr. Wolley of Edinburgh. In the following month another paper appeared in the same periodical by Mr. Baker of Bridgewater, and a third in September by M. Julian Deby, in which the little animal is

designated the *Lisso-triton Palmipes*, and a description is there given which agrees with the observations of the two former gentlemen.

Mr. Baker was the first person who discovered the new species in England in 1843, and Mr. Wolley the first in Scotland in 1848.

By the kindness of these two gentlemen I obtained more than one hundred of these Tritons, male and female. I put them into a pool which I made for the purpose in a secluded spot in a garden, which I supplied with aquatic plants, and surrounded it with clay and stones as a retreat during hibernation.

I closely observed their habits and their periodical changes during two years, and found them the same as in the *Triton lævis*.

The characteristics of this Triton are, according to M. Deby, in the male—1st. Tail suddenly truncate before the apex, and terminating in a slender filament 3 lines in length; 2nd. Hind feet perfectly palmate, all the toes united by a membrane; 3rd. The dorsal crest small and simple; 4th. Size much smaller than the *punctatus* (Pl. XVI. fig. 8).

I have fully ascertained the changes when the breeding season is over. The slender filament is absorbed, and the truncated portion of the tail becomes obtusely rounded off with a slight indurated dark tip at the end, and the web on the hind feet is wholly absorbed, leaving the toes free (Pl. XVI. fig. 9).

Being the smallest of the Tritons, it may be designated, I think with great propriety, *Triton minor*.

I would propose as a new nomenclature for the three Tritons now *fully* recognized in Great Britain—1st. The *Triton asper*; 2nd. The *Triton lævis*; 3rd. The *Triton minor*.

I would here remark, that my observations have led me to the conclusion that there is only one genus of the Triton. The rough skin of the one species and the smooth skin of the other does not appear a sufficient difference to form another distinct genus, their habits are all alike, and the variety of their changes are also the same.

The Tritons left my pool between the 11th of August and the 4th of September, and I found them under large leaves growing near the pool, having undergone their changes for terrestrial life and for subsequent hibernation.

I had also in this locality an opportunity of corroborating my former statement, that the tadpole of the Triton requires five months at least of genial weather before it arrives at its full development so as to be able to leave the water; the tadpoles produced from the ova deposited in the month of July remain in the water through the winter, apparently undergoing no change,

and only become fully developed in May and June, at which time they leave the water. This fact can only be proved satisfactorily in those pools where there are only the *Triton lævis* or the *Triton minor*; if the *Triton asper* were in the same pools, the tadpoles would fall victims to their voracity before they arrived at their full development.

During several unusually mild days at the latter end of December 1850 and January 1851, I saw that three of the full-grown Tritons had left their place of hibernation and were in the shallow part of the pool; they only remained there a few days.

In conclusion I have endeavoured to prove—

1st. That there are only two species of Triton in the midland counties of England.

2nd. That the tadpole of the Triton remains in the water until the branchiæ are absorbed and the legs become sufficiently strong to enable it to leave that element, and does not usually return to it again until the expiration of the third year.

3rd. That during three years it is a land animal, in a state of activity in the summer, and of hibernation during the winter.

4th. That the Triton is three years before it propagates its species, and four years in arriving at its full growth.

5th. That it revisits the water in the spring for the purpose of reproduction and leaves it early in autumn.

6th. That fecundation is accomplished through the medium of water, and not by actual contact.

7th. That a very dry or a very wet situation are both fatal to the Triton when in a state of hibernation.

8th. That the habits and changes of the new Triton are in accordance with the other species.

Nottingham, Oct. 14, 1853.

EXPLANATION OF PLATES XV. and XVI.

Figs. 1 & 2. *Triton asper* of the first and second year's growth.

Fig. 3. The male *Triton asper* of three years' growth during the season of reproduction, with a small crest and a persistent silvery stripe on the tail.

Fig. 4. The male *Triton asper* of four years' growth during the season of reproduction, with a full crest and expanded tail of a lanceolate shape.

Fig. 5. The male *Triton asper* of four years after leaving the water preparatory to hibernation, the crest and the expansion of the tail being absorbed.

Fig. 6. The full-grown male *Triton lævis* during the season of reproduction, with crest and fringed hind toes.

Fig. 7. The full-grown male *Triton lævis* after it quits the water, preparatory to its hibernation, destitute of crest and of the fringe on the hind toes.

Fig. 8. The full-grown male *Triton minor* during the season of re-

production, with a small crest, webbed hind feet, and a slender filament at the extremity of the tail.

Fig. 9. The full-grown male *Triton minor* after leaving the water, destitute of crest, web on the feet, or slender filament on the tail, all having been absorbed.

XXXV.—*Notes on some new or little-known Marine Animals.* (No. 3.) By P. H. Gosse, A.L.S.

Class CRUSTACEA.

Fam. Crangonidæ.

Crangon spinosus (Leach). The Spinous Shrimp.

A specimen brought me Sept. 1st is slender as compared with *C. sculptus* and *fasciatus*. Its ground colour is drab or pale wood-brown, with a defined band of opake white across the fourth segment, a much broader one across the front of the carapace, and an irregular broad white band running down longitudinally on each side, so as to unite these two, leaving an oblong mark of drab insulated in the middle ; a broad band of which crosses the tail-plates. The under parts of the body and the legs are spotted with crimson.

Crangon trispinosus (Hailstone). The 3-spined Shrimp.

This species was not uncommon early in June in Weymouth Bay, but ceased to occur from that time until the end of August, when half a dozen were again dredged. Some of them were an inch and a half in length. Their colour consists of a vast number of ruddy-golden stars closely set, interspersed with black and pale specks, on a pellucid grey ground. On the fourth abdominal segment there is a speck of pure opake white, in the median line, near its hind edge : this speck, though occasionally obsolescent, appears to me to be so constant as to be characteristic. The manners of this Shrimp are exactly those of its congeners, burrowing in the sand, or rather sinking into it, by the rapid displacement of it by means of the false feet.

Class ANNELIDA.

Fam. Amphinomidæ.

Euphrosyne foliosa (Aud. et M.-Edw.). The Leafy Euphrosyne.

A little worm which I presume to be this species, I obtained by dredging in Weymouth Bay, August 9th. The minute antenna at the tip of the caruncle appears to be flattened and trun-

cate, instead of subulate; and the colours of the little animal are less vivid than those ascribed by its learned describers to *E. foliosa*. I should designate the hue of my specimen a bright cinnamon-red, rather than cinnabar, and the median line of the ventral surface is purplish. Its length is $\frac{3}{4}$ inch.

As the species named is, however, the only one which these zoologists recognise as European, I presume the present must be identified with it. I am not aware that any *Euphrosyne* has been before detected on the British coasts.

Fam. Nereidæ.

Lysidice rufa (mihi). The Red Lysidice.

Length $1\frac{1}{2}$ in. to 2 in.; width $\frac{1}{12}$ in. Segments 70. Body subcylindrical, almost equal in thickness throughout, and not at all diminishing posteriorly.

Head of two rounded lobes, notched rather than divided. Eyes two, round, black. Antennæ three, of the same form and size, rounded and constricted at the base, conical, pointed, white; the central one in advance of the others, without any accessory tubercle.

First segment about half as long again as the following. The feet commence on the third segment. The fourth segment is pellucid white, slightly swollen, and appears in some degree to sheath those before it, in contraction.

Feet rounded and obtuse. Superior cirri conical, reaching just beyond the foot; inferior cirri small. Bristles white; aciculi black. They continue to the very last segment, which is as large as the rest, truncate, with a central depression, with no terminal styles or tubercles.

Jaws deep black, visible through the rings, but often protruded, and widely expanded.

Colour above indian-red, each segment studded with numerous white round dots; some of these begin, about the fifteenth segment, to arrange themselves in a line across the middle, and this transverse line becomes more conspicuous on the following segments, and forms a ridge. The crimson contents of the dorsal vessel are visible as a medial dark red line down the body. Head whitish, dotted with brown. Under parts pearly, mottled with purplish red on the anterior half.

The bristles of the ventral bundle are of the form which MM. Audouin and M.-Edwards have called "*poils en serpe*," the staff of which is dilated at the extremity and very obliquely truncate, and the accessory piece knife-shaped with the tip and the heel projecting, and a small but well-marked straight tooth near the tip; a slender lamina just embracing all. This form

differs specifically from that figured by them as belonging to *Lysidice ninetta* (Litt. de la France, ii. pl. 3 B. fig. 8).

Others are simple lancets, as fig. 7 of the same plate, except that the dilated head has but one curvature, and that the point is drawn out to much greater length and fineness.

The specimen above-described was found on an oyster dredged off Lee, near Ilfracombe, in September. It was rather inert, but crawled slowly about, and when much disturbed, threw itself into figure-8-contortions. No species of the genus is enumerated by Dr. Johnston in his Index to the Brit. Annelides (Ann. N. H. No. 108).

Class ZOOPHYTA.

Fam. Corynidæ.

*Spadix Cocksii** (*S. purpurea*, mihi) is sufficiently numerous about the ledges under Binkleaf, adhering to the under surfaces of stones in the Laminarian zone. Some specimens can extend themselves to an inch and a half in length, and contract the papillose head to a lump almost globular. The papillæ of one which was active, and much extended, assumed, under the microscope, very distinctly the form of the tentacles in *Coryne*, each consisting of a somewhat thick, pellucid, cylindrical, flexible neck, and a terminal, globose, opake head. Of its place in this family I have scarcely any doubt.

Weymouth, Nov. 1, 1853.

XXXVI.—*Descriptions of some undescribed species of Reptiles collected by* Dr. Joseph Hooker *in the Khassia Mountains, East Bengal, and Sikkim Himalaya.* By J. E. Gray, Ph.D., F.R.S., V.P.Z.S., P.B.S. &c.

Dr. Joseph Hooker, on his return from Thibet, Sikkim, and Khassia in Eastern Bengal, kindly sent the Reptiles he had collected to the British Museum: as several of them have proved to be hitherto unrecorded in our Systematic Catalogue, I herewith send you for publication in the 'Annals' short descriptions of the new species.

* Since the above was sent off, Mr. Cocks's note on this animal appeared in the November Number of the 'Annals.' The generic name *Arum* is not admissible, as it belongs to a well-known genus in botany; I gladly recognise, however, the superior claim of the specific appellation, which pays a deserved compliment to an excellent naturalist.

Fam. Agamidæ.

Calotes Maria.

Calotes Maria, Gray, Cat. Lizards B.M. 243.

Hab. Khassia Hills, Affghanistan.

Biancia.

Head pyramidal, quadrangular, covered with small nearly equal keeled scales. Nostrils small, on the side below the nasal keel. Ear-drum hidden beneath the scales. Throat with a compressed pouch covered with uniform small keeled scales, not keeled or edged, with compressed scales in front. Nape with a crest of high, and back and tail with a crest of low compressed scales; sides of nape and cheeks spinous. Body and tail rather compressed. Scales of the back moderate, nearly uniform, rather unequal, keeled in rather oblique cross rows; of tail and outside of limbs rather larger; of under side of tail and belly much larger, rhombic, and more strongly keeled. Toes 5 · 5, elongate, unequal; femoral and preanal pores none.

This genus has most resemblance to *Calotes*, but is at once known from that genus, and the rest of the group of *Agamidæ*, by the absence of the ear-drum: the form and distribution of the colours put one in mind of the American genus of Iguanidæ, *Leilolemus*.

Biancia niger.

Black, yellow varied and banded. Head with a broad yellow band from eye to eye. Back, with angular cross bands and a streak from the back edge of the eye along the nape to the first cross band and lips, yellow. Chin and under side of body yellowish white.

Hab. Sikkim.

In young specimens the yellow colours form more distinct bands, the sides of the neck are yellow, with broad black streaks, including a yellowish central line, and the sides are black with large round yellow spots, leaving only a black net with roundish meshes between the spots.

Japalura.

Head subquadrangular, pyramidal, covered with small nearly equal keeled scales. Nostrils small, on the side below the nasal keel. Ears hidden under the skin. Throat lax, with a transverse fold behind, covered with small keeled scales which are much smaller behind. Nape, back and tail with a low crest of compressed scales; sides of the nape and cheeks spinose. Body

rather depressed. Scales of the back small, keeled, with scattered large keeled scales, sometimes placed in oblique cross rows; of outside of limbs larger, keeled, with some larger scales in cross series; of tail, of chest and belly larger, rhombic, keeled, the keels forming longitudinal ridges. Tail slender, with small keeled scales and some rather larger ones forming longitudinal ridges. Toes 5·5, unequal, elongate, slender; femoral and preanal pores none.

This genus has much the appearance of the African *Agamæ*, but differs from them in the ears being covered with the skin and scales.

Japalura variegata.

Pale brown in spirits; varied with dark irregular brown streaks on the side of the neck. Back and tail with irregular dark brown bands, edged with a narrow white line. Legs with broad dark brown cross bands. Lips, chin and beneath whitish brown.

Hab. Sikkim Himalaya.

Fam. Scincidæ.

Tiliqua rufescens, Gray, Cat. Rept. B.M. 109.
Lacerta rufescens, Shaw.

Hab. Sikkim Himalaya.

Common in most parts of India. Mr. Hodgson sent it from Nepal.

Hinulia Indica.

Pale brown, with a few dark spots; sides with a broad black streak edged above with a very narrow white line on the upper part of each side, beneath white, lower part of the sides pale brown, white dotted and marbled; lower eyelid white edged; eyebrow shields 4·4.

Hab. Sikkim Himalaya.

Plestrodon Sikkimensis.

A square scale between the nasal and loreal. Ears denticulated in front, dark green, with metallic reflections near the head and on the sides of the back; sides with a broad black streak minutely speckled with bright metallic green. Chin whitish-green on the side, and black spotted. Crown, cheeks and lips olive, with black edges to the shields.

Hab. Sikkim.

The two other species of this genus belonging to the section with the additional cheek-shield are from North America, but one of them, *P. quinquelineatus*, is also found in Japan and

Australia, being the only instance on record of a lizard having such an extensive geographic range; some have supposed that it may have been introduced by American ships to the two latter localities.

Fam. Zonuridæ.

Sect. 1. *Pseudopina.*

Dopasia.

Head pyramidal; super-nasal shields small, numerous, three pair; the first pair with a small central intermediate super-rostral scale; the hinder pairs broader, transverse; a small central frontal scale, with a larger scale on each side in front of the large hinder frontal plate. Nostrils lateral, in a small nasal plate. Ears very small, open. Cheeks and temples covered with small scales. Vertebral shield elongate, surrounded by a series of smaller shields; occipital shield triangular, with an oblong shield on each side, and a small triangular one behind it. Eyelids distinct, covered with thin imbricate scales. Body cylindrical, with a deep groove on each side. Scales keeled, becoming smoother. Limbs none.

Dopasia gracilis.

Brown; back with a few small white-edged dark spots; sides with a broad continued blackish streak to the end of the tail.

Pseudopus gracilis, Gray, Cat. Rept. B.M. 56.

Hab. Khassia Hills.

Believing that this species had the rudimentary hinder limbs of the European and Northern Asiatic genus *Pseudopus*, I referred it to that genus when I described it in the Catalogue of Lizards in the Collection of the British Museum; a more cautious examination of a better specimen has shown that it has no such members, and hence agrees with the American genus *Ophiosaurus* or Glass Snake: some peculiarities in the scales of the head induce me to separate it from that genus and form one for it. This is not the only instance of a similarity of the Northern Indian reptiles with those of the New Continent.

Fam. Colubridæ.

Coronella punctiulatus.

Pale brown, closely minutely black punctulated with obscure rather distant narrow dark cross bands placed in pairs; beneath paler. Ventral shields very obscurely keeled on each side, the keels marked by a continued whitish streak, and often with a square black spot occupying all the shield above the keel. Tail

rather short, ending in a conical rather compressed horny point; subcaudal plate two-rowed. Eye moderate, pupil round.

Hab. Khassia.

Coronella callicephalus.

Pale brown; lips and beneath paler. Head brown, with a distinct central black band on the crown, and a streak from the back edge of the eyes extending over the temple to the first cross band. Back with a black streak on each side which is very narrow and interrupted, commencing about the middle of the body, and becoming gradually broader and more continuous until it forms a rather broad streak on each side of the upper surface of the tail; and with very broad rather irregular blackish cross bands edged with a narrow black and pale yellow front and hinder margin. Scales smooth, ventral shield rounded. Eyes moderate; head-shields distinct; superciliary shield triangular; one anterior and one posterior ocular shield and a distinct square loreal shield; the hinder nasal shield larger than the loreal; subcaudal shields two-rowed.

Hab. Khassia.

Psammophis collaris.

Olive, very minutely black speckled, forming darker edges to the scales, and a broad rather darker band on the lower part of each side; a broad band across the nape, two indistinct narrow bands across the crown, a series of spots on the middle of the front of the back along each side of the ventral shield, becoming confluent behind into a more or less continued narrow streak on the side of the tail, and a narrow streak on each side of the face through the middle of the eyes to the temple, black. Lips, under part of body, and band across the temple and behind the black nuchal spot, white; scales smooth, thin. Head rather short. Eyes moderate, pupil round, one anterior and two posterior ocular shields and one small loreal shield.

Hab. Khassia.

In *young* specimens the vertebral spots are continued to the tail; there is a series of very small black specks on each side of the middle of the front ventral shield, and the labial shields are dark-edged. The upper end of the ventral shield is olive and minutely speckled like the lateral scales.

Coluber radiatus.

Old and young.

Hab. Sikkim; Khassia Hills.

Herpetrodryas frenatus.

Green; lips and beneath white. Head with a broad black streak

across the eye to the side of the neck. Eyes rather large. Scales smooth; ventral shield obtusely keeled on each side, with an opake white narrow streak at the keel.

Hab. Khassia.

Like *H. tricolor*, Schlegel, Phys. Serp. 187. t. 6. f. 16. 18, from Java, and *H. Olfersii*, Schlegel, *l. c.* 183. t. 7. f. 14. 5, from the Brazils, in colour, but has a larger eye than the former, and not so large a one compared with the size of the head as the latter, besides other characters.

Tropidonotus umbratus.

Hab. Sikkim; Terai.

Tropidonotus stolatus.

Hab. Khassia.

Fam. Crotalidæ.

* *Second labial shield very high, forming the front of the suborbital pit, the third large; back uniform greenish, with a white lateral streak.*

1. *Trimesurus viridis*, Lacép.; Cat. Snakes Brit. Mus.

Green beneath, white sides, with a white and brown nearly continuous lateral streak; superciliary shield large, oblong.

Coluber gramineus, Shaw, and
Vipera viridis, Daud., both from Bodroo Pam (Russell, Ind. Serp. i. t. 97. f. 10).

Hab. Sikkim Himalaya.

Appears to be spread over all parts of continental India.

The lower half of the lowest series of scales is bright brown, the upper half of the tip white, forming, with the indistinct spot on the lower edge of the second series of lateral scales, the white lateral streak; the superciliary shield is large.

2. *Trimesurus elegans.*

Green, beneath paler, whitish; scales of the back moderate, smooth, not keeled, the lateral series rather broader, the first lateral series green, with a small white spot on the hinder part of the upper edge forming an interrupted lateral line; the superciliary shield very small, rudimentary, linear.

Hab. Sikkim.

Known from the former species by the small size of the superciliary shields, the smooth scales, and the narrowness of the lateral streak, and by the absence of the reddish brown streak beneath it.

** *Second labial shield very high, forming the front of the suborbital pit, the third large; back uniform, without any white lateral streak.*

3. *Trimesurus bicolor.*

Green; lips, chin and beneath whitish, without any lateral streak; scales keeled; superciliary shield rather narrow, small.

Hab. Sikkim ?

This species is much larger than any of the white-streaked species I have seen.

Parias maculata.

Pale brown (in spirits); back, a central series of large broad irregular black spots, rather cross-shaped in front, and more transverse and band-like behind, and with two series of smaller squarish spots on each side; belly pale brown, darker marbled, with a rather wavy broad brown streak on each side. Head black, with a narrow white streak from the eyebrows to the ears, and a streak from the back edge of the eyes to the gape. Lips white varied. Tail, end pale brown.

Hab. Sikkim.

Length 10 inches, but probably young. In the older specimens the colours may not be so defined; the second labial shield very large, edging the frontal pit; the shields on the front of the nose three, distinct, the central one small, the others large; superciliary shields large, they and the scales all smooth.

Fam. Bufonidæ.

Bufo scaber, Daud.

Hab. Sikkim, 9000 feet above the sea.

This species is common in most parts of India, also in Java.

Fam. Cæciliadæ.

Ichthyophis glutinosus, Gray, Cat. Brach. B.M. 60.
Cæcilia glutinosa, Linn. *C. viscosa,* Latr.

Hab. Khassia.

I do not see any difference between this and the specimen from Ceylon. Dr. Cantor records it as found in Singapore and Assam.

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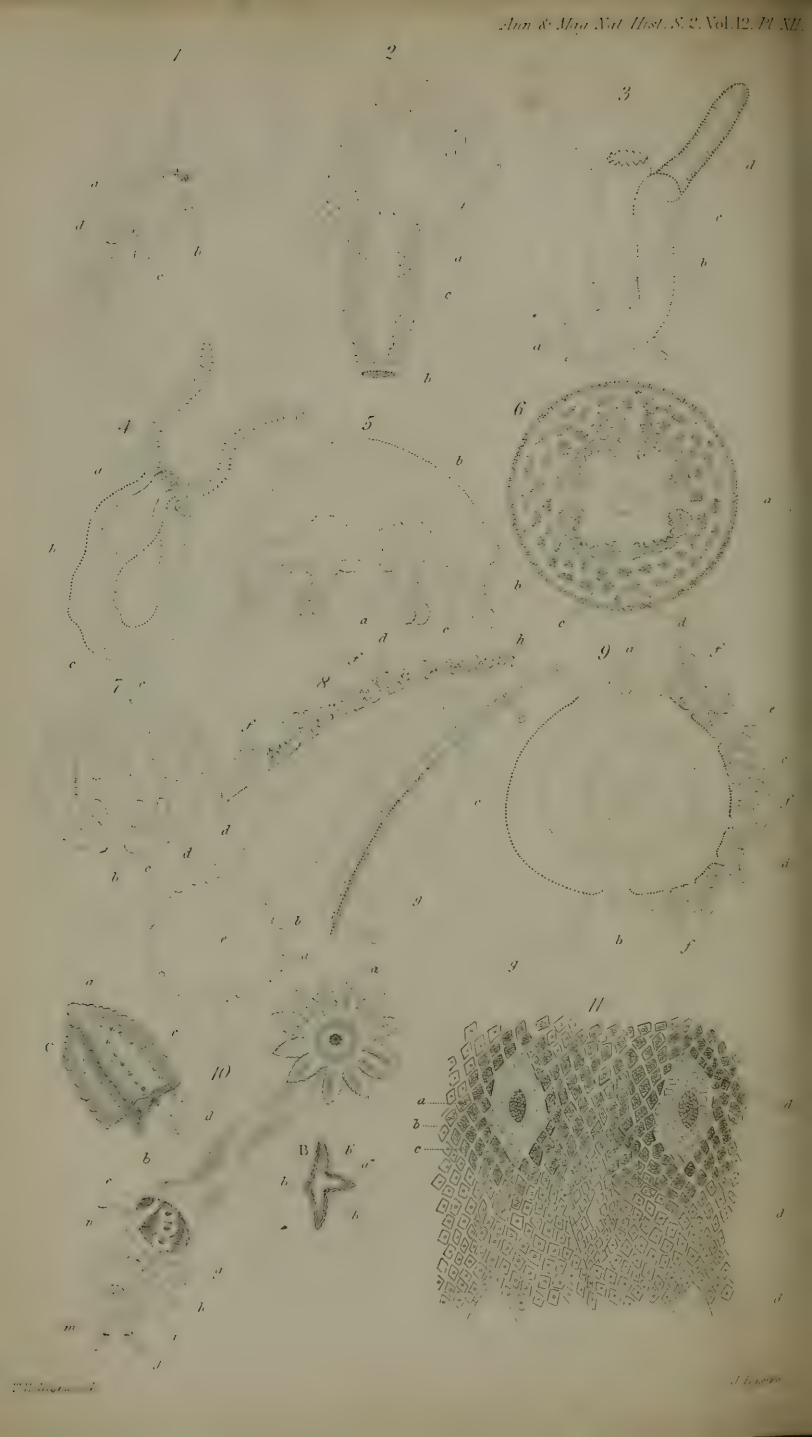
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XXXVII.—*On the Mechanism of Aquatic Respiration and on the Structure of the Organs of Breathing in Invertebrate Animals.* By Thomas Williams, M.D. Lond., Licentiate of the Royal College of Physicians, formerly Demonstrator on Structural Anatomy at Guy's Hospital, and now of Swansea.

[With a Plate.]

[Continued from p. 348.]

Annelida.—In the Annelida the function of respiration is discharged under two remarkably distinct conditions. Under the first, the chylaqueous fluid *alone* is subjected to this process; under the second, the blood-proper exclusively fulfils the office. The mechanical organs subservient to this function under the former, are constructed on a plan diametrically different from that of those provided under the latter circumstances. In the Annelid the true-blood and chylaqueous fluid, though coexistent in the same organism, constitute two perfectly distinct and independent fluid systems. There is between them no *direct* communication of any sort; they are *physically* very dissimilar fluids. An order of branchial processes, intermediate between the two preceding, must also be recognised, in which in equal or unequal proportions the chylaqueous fluid and the blood-proper, either in the same or in distinct appendages, participate in the process of respiration. The branchial appendages affect four different situations on the body: 1. on the head; 2. along the back; 3. along the sides, and 4. at the tail. The first rank under the Cephalobranchiata, the two succeeding under the Dorsibranchiata, the fourth are represented by the *Clymenidæ*. The *Abranchiate Annelida* resolve themselves also into two distinct divisions; those, first, which breathe through the agency of the chylaqueous fluid, and those, secondly, which expose the true blood. Both these groups would be comprehended under the *Cryptobranchiata* of Dumeril.

To these extrêmes, too, an intermediate order occurs; it embraces the *Nemertinidæ*, the *Liniadæ* and the *Gordiusidæ*, the cutaneous external surface of which is wonderfully and richly ciliated. In these unfamiliar genera the chylaqueous fluid and the true blood share, in unequal measure, however, the office of appropriating oxygen. Thus in succinct language has been defined "the heads" under which, in this interesting class, the mechanical conditions of respiration must be studied by the anatomist. The breathing is accomplished in every species, the *earth-worm* not excepted, in strict conformity with the *aquatic* principle. No known Annelid respires on the atmospheric model. In *every Annelid* the blood, though variable in colour,

is *non-corpusculated*. The converse is true of the chylaqueous fluid. No instance is known in which it does not abound in regularly and determinately organized floating cells. The physiologist recognises in these facts the presence of experimental conditions of the highest interest. When the branchial organs carry blood, perfectly devoid of morphous elements of any description whatever, yet fulfilling the purposes of breathing, the floating cells of the fluids are shown to be *not necessary* to the interchange of the gaseous elements concerned in this vital process. On the basis of these unequivocal and visible facts, it is not rash to erect the rule that the floating corpuscles of the organic fluids enact *no share whatever* in the *first* stage of the respiratory process,—that is, in that which comprehends the mere ingress of oxygen and the egress of carbonic acid; *their* office, however it may be hereafter defined, has reference to the subsequent assimilation of the oxygen with the proximate principles of the blood. Through the instrumentality of the corpuscles this quickening element is probably coerced into chemical union with the integral constituents of those principles from which a new compound eventuates.

No class of invertebrate animals unmasks so completely to the eye of the scientific observer of nature the physical machinery through which the function of breathing is fulfilled as that of the Annelida. Gifted with brightly coloured blood, every ramuscule of the blood system can be tracked to its finest extremes. Nature is more comprehensible in her humblest efforts than in her master-pieces. Her plans are susceptible of readier recognition. The intentions of the faultless Artificer are less equivocally apparent. Subtlety gives place to simplicity, obscurity to light.

The Annelids are emphatically inhabitants of the sea-shore. They are seldom afloat. Always accessible in their littoral haunts, they invite the zootomist to demonstrate in *their* organization those abstruse theorems of vital dynamics which in other beings transcend the genius of science.

The *branchial* appendages in the genus *Serpula* are grouped in erectile tufts around the head. Projecting in a comb-like form from the cephalic extremity, and tinted variously and beautifully in different species, they are admirably adap d for the exposure of the blood to the agency of the surrounding water. Each process is supported by a camerated frame or basis, large and distinct at the thick edge of the comb, from which, on one side only, projects a double row of secondary processes. This supporting framework is composed of an extremely flexible and delicate cartilage, the chambers of which are filled wi h a limpid fluid which is in communication with that of the peritoneal

cavity; an afferent and efferent vessel, carrying red blood, disposed in parallelism, accompany this axial framework. In the secondary processes corresponding to the teeth of the comb, the two vessels affect the inferior margin, to which the vibratile cilia are limited. These cilia are large and vigorous in action. Those of all the gills conspiring, generate a current in the surrounding water which bears in the direction of the mouth. The cilia answer therefore a double purpose: they ceaselessly renew the aërating element in contact with the branchiæ and convey food in the direction of the mouth. It is difficult to avoid contrasting the importance of *such* results with the incomplex simplicity of *such* means. Tubicolous and sedentary in their habits, the branchial appendages in the *Serpulæ* subserve thus at once the two highest functions of the organism. In this genus, *Serpula*, it is the blood-proper exclusively that is subjected to the respiratory process.

The branchiæ in the allied genus *Sabella* conform in ultimate structure with those of the Serpulans; they present, however, a somewhat modified disposition around the head.

In *S. unispira* they exhibit an elegant spiral arrangement around a tapering vertical central pillar. When fully expanded, no object in nature is more beautiful: the elementary parts are comb-like; the straight processes, describing a graceful cork-screw curve around the axial stem, are multiplied by a double row of lesser filiform appendages; these latter are richly ciliated on the under surface. They carry each an afferent and efferent vessel: on the margin of extension they are strengthened by a delicate axial scaffolding of flexible cartilage. They are capable of being folded up in a small compass and withdrawn into the tube: they are extraordinarily irritable and contractile. The feet in this genus bear no branchiæ. In *Sabella à sang vert* the branchiæ rise above the head in gorgeously coloured and circularly arranged plumes: they coincide with those of the former in minute structure.

Sabella vesiculosa exhibits a slight variation of plan as compared with those of the former, in the character of the branchial processes. They are supported upon a pedunculated base: this latter is painted with spots of the gayest colours. In *Sabella à sang vert* the blood displays a deep grass-green colour; in the other species it is red. How incomprehensible such capricious freaks of nature!

The genera *Sabella* and *Serpula*, then, may be thus characterized as respects the organs and the manner of breathing. In all species the branchiæ affect a cephalic situation; the blood-proper, and not the chylaqueous fluid, is aërated; in all, the pedal appendages consist only of setæ; in all, the inferior half

of the alimentary canal is richly ciliated *internally*, a singular provision for propelling an incessant current of water from one end of the body to the other. Such a current must necessarily part at once with *its dissolved oxygen* and its suspended organic particles. The former acts upon the chylaqueous fluid contained in the *hollow* cylinder embracing the canal. This is artfully accomplished *internal* respiration!

The genus *Sabina* has been recently constituted by the author to receive several species of tubicolous Annelids which present an organization intermediate between that of *Sabella* and that of *Amphitrite*.

Sabina Poppæa expresses the generic type. The branchiæ consist of a group of short flexible processes pluming the head; they support short rudimentary secondary processes, highly ciliated; each carries a looped blood-vessel. *These* appendages aërate only the true blood: others, of a quasi-tactile character, and of unusually large size, are provided, which assume an occipital situation; they amount to three in number on either side; they are *tubular, non*-ciliated, fleshy appendages; they are penetrated by a large current of corpusculated chylaqueous fluid; they are obviously designed to oxygenize this latter fluid; they are, at the same time, subservient to purposes of touch and defence.

In *Amphitrite vel Sabella alveolata* these semi-tactile filaments, similarly situated, are considerably greater in number. Unlike those of the former genus, they are ciliated; they are hollow tubular filaments; destined to aërate the chylaqueous fluid, they communicate openly with the visceral cavity. In *A. alveolata* the true-blood branchiæ are distributed over the dorsal aspect of the body; they constitute tapering, prominent, blood-red, highly ciliated appendages carrying in their interior axially a single longitudinal blood-vessel, which at the distal extremity returns upon itself. The chylaqueous fluid also penetrates in small quantities into the interior of these processes. By M. Quatrefages* a complex *subdivision* of the blood-vessels in these processes is figured and described. An *appearance* leading to such an error may be easily produced by pressure. A *spirally* arranged line of vibratile cilia, coiling from the base to the apex of each appendage, provides for the constant renewal of the aërating medium †.

In *Amphitrite auricoma* the branchial combs are attached by a single root, expand and divide in a pectinated manner, each tooth carrying only a single longitudinal vessel. This species

* "Organisation des Hermelles," Ann. des Sciences, 3me série, 1848.

† For illustrations of many of the parts described in the text, the reader is referred to the Report of the Trans. of the Brit. Assoc. for 1851, on the British Annelida.

indicates a transition from the typical *Amphitrite* to the genus *Terebella* (fig. 1. Pl. XIV.). In all the species of the latter genus the branchial organs appear under the form of blood-red tufts (fig. 1, *a*), proceeding from three or more separate root-vessels on either side of the occiput. The vessels divide for the most part dichotomously, forming an arborescent bunch of *naked* florid branches: each ramuscule is enclosed in a delicate cuticular envelope (fig. 3, a^2) *perfectly destitute* of cilia, and conveys to its extreme end a single vessel looping upon itself (fig. 3, *m*). Although extremely transparent and attenuated, the epidermal coating must include contractile fibres, since each branch may be emptied, rendered bloodless and shrivelled, by the compression of the parietes. This provision for reinforcing the central circulating powers exists in various parts of the blood-system of the Annelida. It may be affirmed, generally, that in all true *Terebellæ* the branchiæ occur under the character of naked, unciliated blood-vessels restricted to the occipital rings of the body. In *T. nebulosa* (fig. 1, A) they constitute thick, florid, resplendent tufts; in *T. conchilegia* they are fewer in number and less prominent. In the smaller species * the cephalic tentacles (fig. 2) of the *Terebellæ* constitute, unquestionably, auxiliary organs of respiration; they are copiously penetrated by the chylaqueous fluid; they carry vibratile cilia on their inferior side (fig. 2, *g*); they are capable of injection by the chylaqueous fluid; they open directly into the peritoneal chamber; they are *tubular*, flattened filaments, furnished with strong muscular parietes; they are admirably fitted to aërate the chylaqueous fluid; they are incessant in their motions; touch is obviously one of their functions; they also act as prehensile organs, conveying food to the mouth; but they are also organs of locomotion; they are fixed suctorially on a surface in advance of the animal, and used as ropes for hauling forwards the body.

In *Terebella conchilegia*, tubicolous and sedentary in its habits, the cephalic tentacles are inferior to those of *T. nebulosa* in number and size. They are differently configurated; they approach the prismatic in outline; in transverse section they present a triradiate shape; in minute structure and mechanism of action, they differ slightly from those of the latter; they are not for locomotive purposes; hence their reduced size and diminished number.

It is not a little curious that in the *Terebellæ* these organs, which are homologous with true cirri, should be so richly provided with vibratile cilia, while the true-blood branchiæ are en-

* Several undescribed *small* species will in a future number of the 'Annals' be figured and defined.

tirely destitute of these motive appendages. Nothing but a correct conception of the nature and capabilities of the chylaqueous fluid will enable the physiologist to unriddle this apparent paradox.

The *Dorsibranchiate* order comprehends a considerable proportion of the class Annelida. "Ils ont leur organes et surtout leur branchies distribués à-peu-près également le long de tout leur corps, ou au moins de sa partie moyenne," says Cuvier. *Arenicola* represents the central genus. In this worm respiration is performed by means of naked blood-vessels projecting at the root of the setiferous processes upwards and outwards one-fourth of an inch, in the adult worm, above the plane of the surface. They are limited in number and distribution to the fourteen or sixteen middle annuli of the body. They are commonly described as forming an arborescent tuft; the division of the vessels is, however, regulated by order and symmetry. When fully injected, the vessels of each branchia form a *single* plane, rising obliquely above and across the body, and immediately behind each brush of setæ. In the adult animal each gill is composed of from twelve to sixteen primary branches, proceeding from a single trunk which arises from the great dorsal vessel: the vessels in the branchial tuft describe zigzag outlines; the secondary branches project from the salient angle of each zigzag. This mode of division, occurring in one plane and in all the smaller branches, results in a plexus of vessels of extreme beauty of pattern,—a captivating example of symmetry amid irregularity, harmony amid lawless variety. Each branchial tuft and each individual vessel possess an independent power of contraction; in the contracted state the tuft almost entirely disappears, so completely effected is the emptying of the vessels. The contraction or *systole* in any given tuft occurs at frequent but irregular intervals; this movement does not take place simultaneously in *all* the branchiæ, but at different periods in different tufts. As there exist no heart-like dilatations in the afferent vessels of the branchiæ, the contractile power with which the exposed branches are endowed, becomes an important means of reinforcing the branchial circulation. The vessels appear quite naked, and if examined in the living state, each ramuscule seems to consist only of a single trunklet; if this were really the case, it would of course resolve itself into a tube ending in a *cul-de-sac*, and the blood movement would be a flux and reflux; but by injection it is easy to show that the finest division of the branchial arbuscle contains a *double* vessel, enveloped in a common muscular though extremely diaphanous sheath. That these vascular sheaths, which are only fine productions of the integuments, are furnished with voluntary muscular fibres, is proved by the rapid

and simultaneous retraction of *all* the branchiæ into the interior of the body, which follows when the animal is touched. This sheathing of the blood-vessels with true muscular coats is a frequent character of the circulating system in the Annelida. In *Arenicola*, as in *all* Annelids in which the vessels are naked, the branchiæ are destitute of vibratile cilia.

To the frequenter of the sea-shore the preceding description of the mechanism of breathing in the familiar lug cannot prove unacceptable. Its fæcal coils are encountered at every step. The animal is ceaselessly occupied in swallowing and rejecting *wet* sand. A considerable amount of water and sand is incessantly traversing the body of the animal from one extreme to the other. The organic particles are appropriated during the digestive process; the water in part yields up its oxygen and in part replenishes the large volume of chylaqueous fluid with which the visceral cavity is distended,—another example of *internal* respiration.

Provided the branchiæ convey to the surrounding medium the blood-proper exclusively, and these organs occur in form of naked vessels projecting above the external surface, the description now given of the branchiæ of *Arenicola* will apply in every minute respect of structure to all other Annelida. It will prove exact in relation to the structure of the gills in the several species of the beautiful genus *Euphrosyne* of Savigny.

In *Euphrosyne laureata* they rise under the protection of the setæ as brightly florid brushes on the back. They are fixed by means of three or four primary trunks. Viewed by transmitted light and under a high power, each ramuscule is seen to consist of a single leafed vessel embraced in a very attenuated musculo-membranous sheath. They are destitute of ciliary epithelium.

An Annelid of great beauty of figure is described by Milne-Edwards and Audouin under the name of *Hipponoë Gaudichaudii*, in which the branchial appendages assume the character of arbuscles of naked vessels garnishing most ornately the entire dorsum of the animal. *Pleione tetrahedra*, the typical species of the genus *Amphinome*, exhibits the breathing organs under the figure of scarlet bunches mounting round dorsadly each annulus of the body, and guarded in front by a bundle of strong bristles. The branchiæ in *Pleione Alcyonia* affect a ventral situation, and exhibit a much less ornamental character.

Chloeia capillata (Savigny) is an Annelid of matchless beauty. The whole line of the back on either side of the median line is decorated with arborescent vermilion tufts. Each tuft is supported by single contracted stems embracing two trunks. They are clothed with a slender musculo-cuticular *un*ciliated membrane. In this rare worm the chylaqueous fluid is abundant, yet no *external* organs are furnished for subjecting it to the agency of the aërating element.

The genus *Eunice* (fig. 4) presents another and different type of branchial vessels. Arranged in a prominent row of bright vessels (*b,c,d,e,f*), standing erect as florid visible combs at the dorsal base of each foot in the body, the branchiæ impart to all the species of this genus a graceful and characteristic appearance. In every species the branchial vessels divide on a uniform plan peculiar to this genus. The primary trunk (*a*) rises vertically along the inner side of the branchia, and detaches from its outer side at regular intervals, straight vessels, which gradually decrease in size from below upwards; each branch forms a straight undividing vessel (fig. 5, *i,j*), curving gently upwards and towards the median line; these branches become *in their number* distinctive of species. In some of the smaller species inhabiting the British coasts, the branchiæ are composed only of a *single* vessel; this is the case also with the *young* of the larger species; in others they vary the single to the number of six or eight. In *Eunice gigantea*, according to the figures of Milne-Edwards, the vessels of each branchia amount to thirty-six in number. These vessels, although perfectly naked and unciliated, like those of *Arenicola*, are both less contractile and retractile; they extend in this genus from the head to the tail, and equal in number the annular segments of the body. In the dorsibranchiate genera, the branchial organs of which are now being described, the true blood circulating in its proper vessels is exclusively the seat and *subject* of oxygenation.

The fluid of the peritoneal cavity, abundant in quantity and highly organized though it be in the genera under review, does not, at least by means of any external organs, participate in this great function. Judged by such a test, the genera of this grand order of worms should be marshalled under two primary groups, of which one would comprehend those in which the function of breathing devolves *exclusively* on the true blood, while the other would be characterized by the fact, that the branchiæ are so organized as to permit separately or conjointly the exposure of the chylaqueous fluid. When the branchial apparatus is penetrated by two separate and distinct fluids, coordinate probably in organic properties, the vascular system of the body will be found in general by so much the less developed by how much the chylaqueous fluid supplants the blood-proper in the branchiæ. The *structure* of the branchial organs becomes thus a significant test of the position of any given species in the Annelidan scale —those being entitled to the highest rank of which the respiratory organs are designed to aërate the true blood, those the lowest in which the chylaqueous fluid alone circulates in the branchiæ.

The subgenera *Lysidice*, *Aglaura* and *Œnone*, of the genus *Eunice*, are distinguished in the circumstances now defined from all the former genera of the dorsibranchiate order. Naked un-

ciliated blood-vessels no longer in them form exclusively the branchial organs; loose and large-celled tissue is superadded to the proper blood-vessels, which are far less in relative size than those in the former variety of branchiæ; into the cells of this tissue the fluid of the visceral cavity insinuates itself, its course being marked by a slow flux and reflux motion. There exists, however, another point of structural difference between the branchial organs of this group and those of the former; this difference admits of the following general expression—that wherever the chylaqueous fluid is admitted into the interior of the branchial organs, the latter are invariably supplied more or less profusely with vibratile cilia.

In the genus *Lysidice* the branchia consists of a flat, lanceolate process, more or less developed, surrounded marginally by a blood-vessel, the mid-space between the lines of the advancing and returning vessels being composed of large-celled lacunose tissue, into which the chylaqueous fluid penetrates by an advancing and receding movement. The branchiæ in *L. Ninetta* are situated dorsally, and are supplied at their bases with single rows of vibratile cilia. Those of *Aylaura fulgida* are similarly constructed, although they differ slightly from those of the former genus in size and figure. In *Œnone maculata* they occur under a more developed form, constituting flattened pointed trowel-shaped processes, the plane of which is vertical with reference to that of the body. A blood-vessel, as in the former case, trends along the borders, immediately beneath the cuticle. The course of these vessels is followed by a row of large and prominent vibratile cilia*.

In the branchial system of the genus *Nereis* (Cuvier), *Lycoris* (Savigny), the minute anatomist encounters a structure strikingly dissimilar from anything hitherto described in the Annelids. Whether round, or laminated, or foliaceous, the true branchiæ in this genus are always penetrated by the chylaqueous fluid, and the blood-vessels assume a peculiar disposition. When the branchial process is conical in shape, its base is embraced by a *reticulated* plexus of true blood-vessels, which are situated quite superficially and immediately beneath the epidermis. These vessels are most prominently developed on the dorsal-most process, which therefore may be called the branchial, but they extend more or less over all the cirri. A better characteristic of the branchiæ in the Nereids is that of being penetrated by the fluid of the visceral chamber. In those species in which the branchial process is conical, the interior of the base only is hollow and filled with chylaqueous fluid. Floating in this fluid may be readily

* See plates in the author's Report on the British Annelida, Trans. of Brit. Assoc. for 1851.

seen, when viewed by transmitted light, coils of naked blood-vessels; in those instances in which the branchiæ are laminated or foliaceous, as in *Nereis renalis*, the blood-plexus on the external surface does not extend beyond the limits of the base of the process, the flat, leafy circumference being tunnelled by straight spacious canals which radiate with great regularity from the root to the expanded border of the fan. In these canals the corpuscles of the chylaqueous fluid may be observed rolling to and fro, advancing and receding in the same channel. These movements are regulated by those of the current in the chamber of the peritoneum. This type of structure prevails in *Nereis renalis*, *N. longissima*, and in a slightly modified form, in consequence of the less flattened shape of the branchiæ, in *N. viridis*. The round or conical variety of branchial process obtains in *N. margaritacea*, *N. Dumerillii*, *N. fucata*, *N. pelagica*, and *N. brevimanus*.

It is difficult to explain why the branchial organs of the Nereids should be entirely destitute of ciliary epithelium.

The laminated or foliaceous type attains the point of maximum development in the branchial appendages of the genus *Phyllodoce*. Anteriorly to the discovery of the vital and organic characters of the chylaqueous fluid, the real uses of the rich leafy expansions ornamenting the sides of these attractive Annelids could only have been rudely conjectured. They look more like oars than branchiæ, natatory more than respiratory organs. In the absence of correct ideas tending to a knowledge of the nature and capabilities of the fluid contents of the visceral chamber, the real meaning of the radiating channels by which the respiratory laminæ are perforated, and therefore of the mechanism of the function of which they are the scene, never could have been rightly apprehended. It was only by mistaking the chylaqueous fluid for the true blood that the branchial office of these appendages could have been predicated, and this very mistake has been committed by M. Quatrefages.

The branchiæ in *Phyllodoce viridis* are prominent dorso-lateral appendages; in this worm the blood-system can be traced only to a few scanty vessels distributed over the roots of these processes: nor are the canals very spacious and distinct; they are more like lacunæ in a spongy tissue.

In *P. bilineata* and *P. lamelligera*, radiating passages, distinct from each other and communicating only indirectly through intermediate cells, are readily observed. They carry the visceral fluid, the corpuscles of the latter being seen flowing and ebbing in the same channel. Nothing can, however, more conclusively prove the true branchial character of these laminæ than the presence of cilia, the vibrations of which can be observed only at

the edges of the respiratory laminæ: these cilia are most conspicuous in *P. lamelligera*. This is a striking point of distinction between the *Phyllodocidæ* and the Nereids, in which ciliary epithelium has no existence. The chylaqueous fluid then may be clearly affirmed as that agent in the œconomy of the *Phyllodocidæ* which is the immediate, *the first*, subject of the respiratory process, the true blood receiving its supply of oxygen from this fluid, afterwards to convey it to the solid structures of the body.

In the genus *Glycera* the blood-proper is entirely excluded from the organs of respiration: this office devolves exclusively on the chylaqueous fluid. The latter in this worm is crowdedly charged with *red*-corpuscles, a remarkable exception to the Annelidan rule. The gills consist of hollow, cylindrical appendages, emanating from the base of each dorsal foot at its superior aspect, filled in the interior with the chylaqueous fluid. It is peculiar to and distinctive of this genus that the *interior* of the branchiæ is lined with vibratory epithelium. Cilia are not detectible on the *exterior* of these processes, but they exist in the *interior*: under the action of these oarlets, the corpuscles of the chylaqueous fluid by which the gill-process is penetrated, move with great rapidity in a definite direction;—peripheradly on one side and centradly along the other, each corpuscle whirling on its own axis as it proceeds. The advancing stream, however, is not divided from the returning. The channel is one, open channel. This is the *law* which is applied to the chylaqueous fluid: it knows no exception. *Its* channels are always single and cæcal: its movements a flux and reflux. Contrarily the orbit of the true blood is *circle*-like, its channels closed, its colour red, its composition non-morphotic.

In the *Syllidæ* (fig. 6) the branchial organs are penetrated only by the chylaqueous fluid. It can be detected only at the bases of the feet (*d*). To this part the vibratile cilia are restricted (*e*). The long filiform, and in some species moniliform or leafy appendages which are described commonly as the branchiæ in these worms, have no central hollow; they are filled with lacunose tissue (*f*) through which the *fluid* parts of the contents of the visceral chamber slowly penetrate. But in the spacious chambers occupying the bases of the feet, the *corpuscles* may be detected in whirlpools. From this fact the inference may be drawn that the corpuscles are not essential to the *first* mechanical stage in the respiratory process—that of receiving oxygen directly from without. The characters of structure just described are very perfectly typified in *S. prolifera*, the moniliform variety is best seen in *S. armillaris* and *S. maculosa*. A similar conformation prevails in the genera *Ioida* and *Psamathe* of Dr. Johnston. In the Syllidan family, which excels all others in grace and beauty,

the blood-proper system is almost indetectible, in consequence of the colourlessness of the contents. The blood does not participate in the function of breathing: it is an office performed exclusively by the chylaqueous fluid.

Amongst the family *Ariciadæ* several other varieties in the configuration of the breathing organs occur. In the genera *Nerine* (fig. 8) and *Aricia* the branchial appendages affect a dorso-lateral situation: they are traversed in every species from base to apex by a single blood-vessel returning upon itself (*i*). This vessel is supported by a lobule of spongy tissue (*f*), into the cells of which the chylaqueous fluid insinuates itself. In every species of this family the branchiæ are supplied by vibratile cilia, exhibiting in each a distinct disposition. In ultimate structure, those of *Amphitrite alveolata* and *Leucodore ciliatus*, remote specifically from the Syllidans, display the same construction.

In the genus *Spio*, abundantly common on our shores, the respiratory organs occur under forms of the highest beauty. They constitute flat membranous penknife-shaped appendages curving gracefully over the back and crossing over the median line, alternating imbricatively with the corresponding processes of the other side. The plane of each process is vertical in relation to the long axis of the body (fig. 8). They are less flat and close in *N. vulgaris* than in *N. coniocephala*; they are largest in size towards the middle of the body, smallest anteriorly and posteriorly. The blood-vessels, the afferent and efferent, run close to and parallel with the inferior border of the process; the upper part of each is composed of a membranous lobular (*g*, *f*) addition to the inferior and vascular portion. Into the cells (*g*) of this lobule the chylaqueous fluid slowly finds its way, and participates obviously in the office of respiration. In *N. coniocephala* it is remarkable that the cilia should be limited in their distribution to the margin along which the true blood-vessel runs. This fact is manifest in *N. vulgaris* in consequence of the smallness of the membranous lobule. In *Aricia Cuvieri* the branchial appendages are more conical in figure, more vertical in position, and developed only at the posterior four-fifths of the body: they are covered with large vibratile cilia. Like those of the former, they are supplied with flat lobules of spongy tissue. In all the members of the preceding family the real branchial organ consists of an evolved or exaggerated development of the superior element of the dorsal foot.

In the genus *Nephthys* (fig. 7, A) which comes now under review, it is the inferior element of the dorsal foot which becomes the subject of this evolution. It is a curved conical process (*a*), attached to the inferior aspect of the root of the upper foot. It is hollow and filled with the chylaqueous fluid, the corpuscles of

which are readily observed on external examination (B, *a*). No cilia exist on the interior surface: they are abundant and vigorous on the exterior. A rich vermilion coil (*b*, *c*) filling the hollow of the process and *floating in the chylaqueous fluid* may be seen by transmitted light. This is a true blood-vessel: it is a single vessel. It is a law in many Annelids that the ultimate blood-vessels do not form plexuses: this proceeds from the extreme mobility of the body. The *quantity* of the blood-proper varies as the Annelidan organism varies at different seasons; it is greatest during the reproductive season, a season during which the chylaqueous fluid is most *reduced* in amount. The two fluids, though coordinate in physiological capacities, are governed by *inverse* laws.

In *Cirrhatulus Lamarckii* and in the allied genus *Ophelia*, a linear series of yellowish blood-red threads, remarkably irritable and contractile, project to a considerable distance from either side of the body throughout its whole length: at the occiput they are grouped over the dorsum. They convey the blood-proper *exclusively* in a *single* vessel of considerable length.

The *Aphroditaceæ* constitute a group of Annelids to which the term dorsibranchiate by no means correctly applies; that is, in the majority of the species embraced in this order no branchial appendages exist either on the dorsum or sides. In all the *Aphroditaceæ* the blood is colourless. The blood-system is in abeyance, while that of the chylaqueous fluid is exaggerated. But it is exaggerated only in bulk; it is not raised in organic composition; its corpuscles are scanty, and its albumen small in relative amount. This unusual fact is explained by the presence of organized corpuscles in the dark chymous fluid which fills the gastric diverticula. The scales or elytra fulfil an important purpose: they rise and fall. In rising under muscular action, they create a vacuum in the space between them and the back, into which the water rushes; in falling or collapsing, the water escapes in a current posteriorly. *These currents of water operate immediately upon the fluid contained in the gastric pouches.* The latter are arranged so as most advantageously to receive the influence of the external aërating element. But they float also in the chylaqueous fluid: this is also in part oxygenized. It is the agent by which this vivifying element is conveyed to the solids of the body; it shares directly in the function of respiration; it receives its organic principles from the contents of the gastric cæca.

It cannot have escaped observation, that there prevails a striking resemblance between the general anatomy of *Aphrodita aculeata* and that of the Asteridæ among the Echinoderms. In the latter, however, the chylaqueous fluid fulfils exclusively the

office of breathing. It intervenes between the contents of the digestive cæca and the aërating element. The link of zoological continuity between the Echinoderms and the Annelids is not more clearly constituted by *Aphrodita aculeata*, than the Cestoid and Trematode Entozoa are joined to the Annelids by the transitional family of the Nemertinidæ. From the Entozoa the latter differ in the extraordinary feature of being embraced in ciliated epidermis. Every part of the external surface of the body in the Nemertinidæ is the scene of active ciliary vibration. No approach to the development of this epithelium occurs in *any* Entozoon. The five genera *Valencia*, *Borlasia*, *Nemertes*, *Polia cerebratulus* and *Oerstedia*, into which M. Quatrefages has distributed the Nemertine Annelids, are exemplified on our coasts.

From the Cestoid and Trematode Entozoa several of these Annelids are distinguished by the presence of *corpuscles* in the chylaqueous fluid. In others of them the fluid conforms in character to that already defined in these parenchymatous worms. To the latter the Nemertinidæ are united by another striking peculiarity, that the cæcal *diverticula* of the alimentary system are filled with a *corpusculated* fluid, which, from the methodized distribution of these parts throughout the body, participates unquestionably in the function of respiration. The Nemertinidæ, intimate though their alliance may be with the Cestoid and Trematode Entozoa in general plan of construction, are separated from the latter in one important particular:—in the Annelids the blood system is obviously present, the blood-proper being brightly red in colour; in the Entozoa the existence of this system must for the present be held as doubtful.

It remains to consider the mode in which the process of breathing is accomplished in the *Abranchiate* Annelids, *i. e.* the leech, the earth-worm, and the Nais.

In all systematic works these worms are summarily dismissed as "breathing by the surface." In *Nais filiformis* (fig. 10) the blood-proper is only very scantily distributed over the cutaneous surface; it is impossible therefore that *it* can be the immediate subject of the first act of aëration. The visceral chamber (*d*) in this little worm is filled with a corpusculated fluid: in this fluid coils of blood-vessels (*f*, *f*) are suspended. The blood-proper systematically, by expressly provided vessels, thus brought into intimate contact with the chylaqueous fluid, interchanges constituents with the latter: the former yields up to the latter its carbonic acid, and the latter to the former its oxygen. The chylaqueous fluid thus becomes to the blood-proper the aërating medium. Respiration thus explained is literally *internal*, but not the less real.

In the instance of the earth-worm the chylaqueous fluid is almost

entirely suppressed, and the visceral cavity obliterated. This vulgar worm, however, does not breathe on the atmospheric, but on the aquatic principle. It dies rapidly in perfectly dry places. Its cutaneous surface is the scene of a dense plexus of blood-proper vessels. It is always enveloped in a stratum of viscid fluid, which is remarkable for the property of absorbing and *dissolving* atmospheric air. This air, brought thus into immediate and intimate contact with the surface of the body, operates directly upon the blood-proper circulating in the cutaneous plexus. In the Abranchiate Annelids as in many of the tubicolous Annelids, the alimentary canal is profusely supplied *always* with a vascular tissue which shares in the respiratory process: this process may be distinguished as the intestinal respiration.

In the genus *Clymene* (fig. 9) the branchial organs are situated at the tail (*c*). In ultimate structure they correspond in every particular with those of the Sipunculidæ—they are *hollow* membranous projections (B) penetrated by the chylaqueous fluid (*e*) in which a coiled blood-vessel (*d*) floats. They are destitute of cilia. They afford the only illustration in the class Annelida of branchial organs specialized around the *outlet* of the alimentary system.

It has now been shown that the branchial organs in the Annelida arrange themselves under two leading divisions, between which a clearly legible line of demarcation exists. Under the one, the blood-vessel-bearing branchiæ occur; under the other, those range which are organized for the exposure of the chylaqueous fluid. Vibratile cilia are never superadded when the blood-proper alone enters the gills; *generally*, when this and the chylaqueous fluid participate in the process; *always*, when the latter alone enacts this function. The mechanism of respiration in the Annelid demonstrates beyond doubt that the agency of floating corpuscles is not required for the *absorption* of the external oxygen. The blood-proper, though coloured, is non-morphotic in *every* species. It has been proved that the tentacles are not simply organs of touch: with a single instrument nature accomplishes various ends. They are subsidiary organs of respiration. They are injected always with the chylaqueous fluid. It is certain therefore that in the œconomy of the Annelid the blood-proper and chylaqueous fluid are co-equal elements; they are convertible proximate principles; they exhibit equal physiological capacities; both are capable of discharging the function of respiration, and both are capable of supplying the solids of the body with the materials of increase.

EXPLANATION OF PLATE XIV.

Fig. 1. (A.) Cephalic end of the body of *Terebella nebulosa*, laid open to show the afferent vessel (*d*) and efferent vessel (*e*) of the true-blood branchiæ (*a*); *c*, denotes a corpuscle of the chylaqueous fluid filling the peritoneal cavity of the body, and communicating directly with the hollow axes of the tentacular filaments (*b*).

Fig. 2. exhibits the extreme end of one of the tentacular filaments (*b*, A) viewed by transmitted light; *f*, vibratile cilia; *g*, ditto, covering the under surface; *i*, a true-blood-vessel *floating* in the chylaqueous fluid, of which the corpuscles are seen rolling out at (*j*).

Fig. 3. Extreme division of one of the true-blood branchiæ (*a*, A); *i*, afferent vessel dividing dichotomously, returning upon itself at *m*, and ending in the efferent vessel (*k*); a^2 & *n*, mark the thin, contractile envelope by which the vessels are embraced.

Fig. 4. Foot and branchial appendage of *Eunice margaritacea*: *m*, afferent vessel entering the base (*a*) of the branchial process, of which *b*, *c*, *d*, *e*, *f*, are five vertical branches. Each branch as seen at fig. 5 consists of a single vessel (*i*) returning in a looped manner upon itself (*j*); *g*, cirrus of superior foot; *h*, inferior foot; *g*, inferior cirrus.

Fig. 6. Foot of *Syllis* —— (Williams*): *e*, cavity enclosed by the foot and filled with the chylaqueous fluid (*d*); *c*, vibratile cilia clothing the exterior; *a*, branchial process; *f*, its lacunose tissue; *e*, exterior cilia.

Fig. 7. (A.) Foot of *Nephthys Hombergii*: *a*, branchial process, depending in form of cirrus from the base of the superior foot: (B.) an enlarged view of the branchial process examined as a transparent object. It consists of a hollow process filled with the chylaqueous fluid, in the midst of which is seen floating a long, undividing, complexly coiled true-blood-vessel (*c*). The process is lined externally by a ciliated epithelium.

Fig. 8. Vertical view of the foot of *Nerine vulgaris*: *k*, cavity enclosed by the base; *m*, corpuscles of the chylaqueous fluid by which it is filled; *h*, *f*, *g*, channels penetrated by the chylaqueous fluid in the fleshy lobules; *i*, true-blood-vessel occupying the hollow of the process; *c*, *d*, flat cirri of the upper and lower feet; *o*, cilia; *a*, *b*, integuments.

Fig. 9. *Clymene Ebiensis*: *a*, mouth; *b*, first row of hooked setæ; *c*, branchiæ projecting from the tail; B, one frill of the branchial process detached and viewed transparently; *e*, *f*, corpuscles of chylaqueous fluid by which the lobules are filled; *d*, true-blood-vessel floating in the fluid.

Fig. 10. A part of the mid-body of *Nais filiformis* viewed by transmitted light—showing the *same* precise relation between the chylaqueous fluid (*e*) and the true-blood-vessels (*f*, *f*) as exists in the branchiæ—proving that although the parts are *internal*, the conditions of respiration are complete: *a*, intestine; *b*, *c*, dorsal and ventral primary vessels; *d*, cavity of the body.

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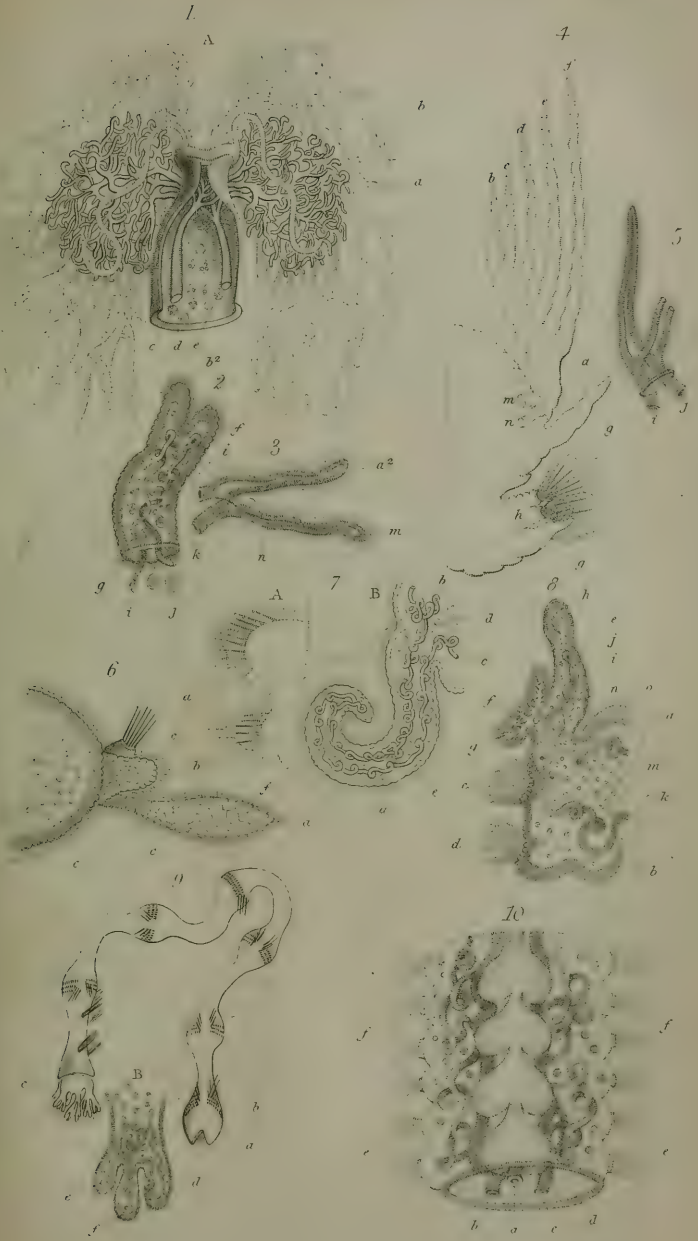
* This species will be described in a future number of the 'Annals.'



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XXXVIII.—*On Blood Rain* (Palmella prodigiosa, *Mont.*). By H. O. Stephens, Esq., Vice-President of the Bristol Microscopical Society*.

[With a Plate.]

The subject of my communication this evening is "Blood Rain," a phænomenon which in dark and superstitious ages filled the minds of the people with terror, who, in ignorance of the nature of such appearances, regarded them as manifest tokens of divine wrath, and harbingers of approaching calamities.

In the same catalogue must be included storms of ink, bloody water, star sloughs, &c. Scattered through various ancient records are to be found indications of the occurrence of the production before us, as having suddenly appeared on various kinds of provisions; and instances are recorded in which the sacred wafer, to the consternation of the worshipers, seemed to be changed into blood.

Growing intelligence and juster views of natural operations have removed these phænomena from the supernatural, yet the nature and structure of the organisms themselves have only very recently been understood.

I am indebted to the Rev. M. J. Berkeley for all the scanty literature on the Blood Rain we possess. The first modern naturalist who has described it in scientific terms is Dr. Sette of Venice, who has published an account of its appearance at Padua in 1819. Dr. Sette named it *Zoogalactina imetropha*, and considered it to be of a fungoid nature.

Ehrenberg saw the same production in the summer of 1848, and, in accordance with his known views and practice of referring so many of the lower organisms to the animal kingdom, described the Blood Rain as *Monas prodigiosa*.

In the same year it occurred to Dr. Montagne at Rouen, covering fowls and cauliflowers, twenty-four hours after cooking, with a layer of blood-coloured matter.

This learned cryptogamist considers the Blood Rain to be an Algoid, and has described it as *Palmella prodigiosa*.

Mr. Berkeley, to whom I sent specimens, says, "Your plants are entirely identical with those of Ehrenberg and Montagne, of both of which I have specimens." Mr. Berkeley thinks it is a Fungal, closely allied to the yeast plant, which is acknowledged to be a submersed form of an *Oidium* or *Penicillium*.

With deference to so great an authority, I demur to this opinion in part, fully according with Mr. Berkeley's views concerning the yeast plant, but believing the Blood Rain to be a

* Read at a Meeting of the Bristol Microscopical Society, Sept. 14, 1853.

true Algoid, and with Dr. Montagne I refer it to the genus *Palmella*.

The history of the appearance of the Blood Rain is as follows:—

I observed at table the under surface of a half-round of boiled salt beef, cooked the day before, to be specked with several bright carmine-coloured spots, as if the dish in which the meat was placed had contained minute portions of red-currant jelly. Suspecting what these might turn out to be, I directed the beef to be placed aside. On examination the next day, the spots had spread into patches of a vivid carmine-red stratum of two or more inches in length.

With a simple lens the plant appears to consist of a gelatinous substratum of a paler red, bearing an upper layer of a vivid red hue, having an uneven or papillated surface.

The microscope shows this stratum to consist of generally globose cells immersed in or connected by mucilaginous or gelatinous matter.

The cells vary in size, and contain red endochrome. As far as I can observe, they consist of a single cell-membrane and contain a nucleus. Treated with sulpho-iodine they become blue.

Mr. Berkeley writes me, "This plant is sometimes of a blue colour, and at other times the cells are colourless." I have seen the cells very pale or nearly colourless, but not blue. Perhaps the colour of this Alga may be dependent on the matrix on which it may chance to grow; and to this I shall again presently refer.

A portion of the beef with the *Palmella* was dried in an oven for several hours, in order to prevent decomposition, and sent to Mr. Berkeley; this rapidly germinated when placed on a paste of rice-flour, and from these the observations recorded in the Gardeners' Chronicle were made.

I placed a few fragments of the Alga on a paste of wheat-flour: in twenty-four hours these minute fragmentary specks grew to spots the size of sixpences, and in forty-eight hours the paste was nearly covered by a layer of blood-red matter, as represented in one of the drawings.

It is stated, that the colour of this Alga is very permanent, and that it dyes silk bright red; this is, I think, corroborated by the fact, that the fibres of the beef on which it first appeared were permeated with the colouring matter of the Alga (Pl. XVII. fig. 1. *e e e*).

I noticed, when sown on rice-paste, the *Palmella* assumed a violet hue, confirming Mr. Berkeley's observation that the cells are sometimes blue (Pl. XVII. fig. 2. *b*).

Perhaps the colour of the plant may much depend on the chemical elements of the matrix: if that happens to be animal

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Fig. 1.

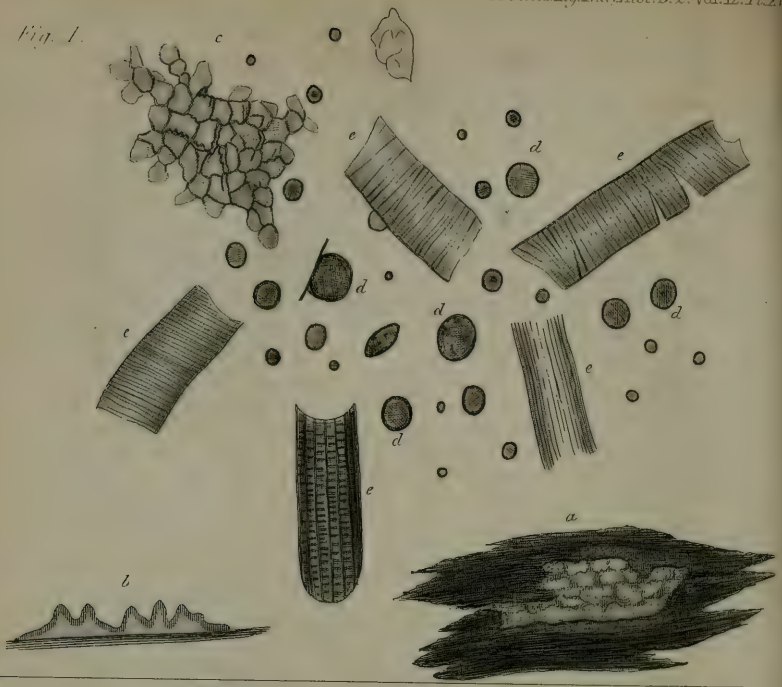
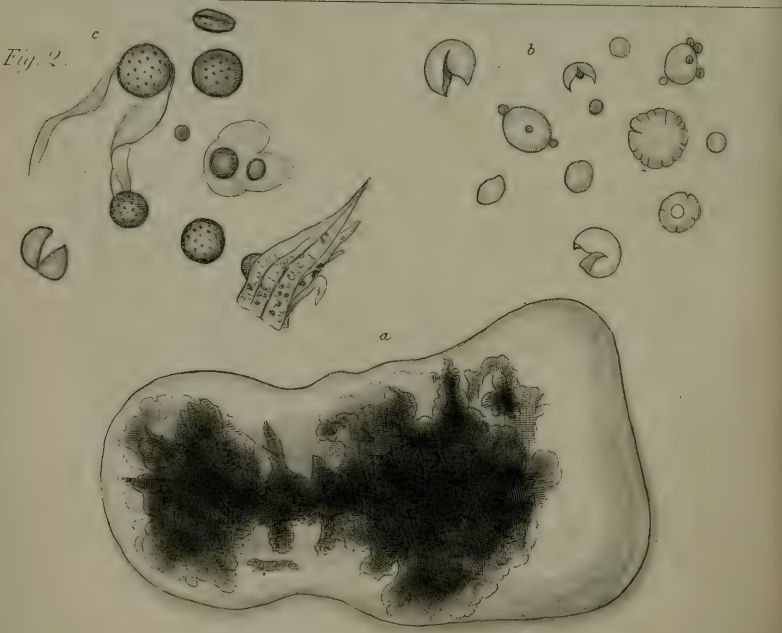


Fig. 2.



matter or flour-paste, or substances rich in nitrogen, a vivid red may be induced; if rice-paste or feebly nitrogenized matters, the colour may tend to blue or violet. But this is at present only conjecture.

Concerning the place in the organic kingdom to which this production ought to be referred, I am of Dr. Montagne's opinion, that it is an Alga, belonging to the *Nostochineæ*, differing from *Protococcus* in wanting the pellucid margin to the globes, and from *Hæmatococcus*, which is furnished with several pellucid rings to each cell, and in which the aggregate granules or cells form a frustulose crust, the frond of the Blood Rain being decidedly gelatinous.

In my judgement this plant is a *Palmella* closely allied to *P. cruenta*, but certainly distinct, the cells or granules of the latter differing from it not only in their colour but size, being very much smaller than those of *P. prodigiosa*.

The mode by which the Blood Rain propagates is extremely curious (as Mr. Berkeley also noticed); it seems to extend itself by elastically spirting a sort of jet or column of red particles, which Mr. B., in a letter, aptly compared to a jet of blood from an artery, and by this mode of propagation, I think, the extraordinary rapidity with which a large surface becomes covered with the Alga can be satisfactorily explained.

A portion of paste covered with the Blood Rain was dried in an oven for forty-eight hours until nearly baked into biscuit, yet fragments of this exsiccated Alga readily grew when scattered on fresh-made dough.

The vitality of the cells of this *Palmella*, like the ova of some fishes, insects, and many other animals of lower grade, is not impaired (within a certain time) by exsiccation even at a high temperature, and when dry retain their germinating powers for a very considerable period, and are disseminated by currents of air and other methods.

Thus the unexpected appearance of this very conspicuous and somewhat portentous-looking production in singular situations and circumstances, can be explained without resorting to far-fetched reasonings or unphilosophical assumptions.

EXPLANATION OF PLATE XVII.

Fig. 1. *a*, *Palmella prodigiosa*, Mont. (natural size), on beef; *b*, perpendicular section; *c*, portion of gelatinous frond, magnified; *d*, cells ditto; *e e e*, fibres of beef stained red by the colouring matter of the Alga.

Fig. 2. *a*, *Palmella prodigiosa* on flour-paste, natural size; *b*, cells highly magnified, some ruptured; *c*, cells with films of mucus acted on by iodine and sulphuric acid.

Bristol, Dighton Street, Oct. 4th, 1853.

XXXIX.—*Descriptions of two new genera* (Pfeifferia *and* Janella) *of Land Mollusca.* By J. E. Gray, Ph.D., F.R.S., V.P.Z.S.

Some years ago I described a new genus of Helices under the name of *Nanina*, remarkable from the mantle of the animal being reflexed and produced over the surface of the shell, like *Vitrina*, but differing from that genus in the shell being more Helicoid, and in the mantle not being produced in front, or forming a kind of shield over the back of the neck; this genus has been very generally adopted, and now contains a large number of species.

The animal of *Naninæ*, like the *Parmacellæ* and *Helicariones*, has the hinder part of the uppermost extremity of the foot truncated and furnished with a linear perpendicular gland with thickened lips.

Mr. Cuming, who lately supplied me with a number of animals of shells in spirit, sent me, along with other kinds, specimens of a shell which Dr. Pfeiffer has described under the name of *Helix micans*, which at once attracted my attention, on account of the shell near the peristome being covered with a thin reflexed portion of the mantle. I at first considered it was a modification of the genus *Nanina* with a more dilated mantle, and a much more globular shell; but on more particular examination, I am convinced that it is the type of a new genus, as the back of the foot is depressed and flattened, and quite destitute of any appearance of a subcaudal gland.

I propose to call this genus *Pfeifferia*, after my excellent friend Dr. Louis Pfeiffer, the author of the "Monographia Helicum," and it may be characterized as follows:—

Pfeifferia.

Animal large for the size of the shell; mantle edge expanded, thin, reflexed over the outer surface of the shell when contracted in spirits, forming an even margin to the outer part of the peristome. Foot moderate, depressed behind, acute at the tips, without any subcaudal gland. Shell subglobose, imperforate, thin, brittle, white, pellucid. Spire with small whorls, third and fourth rapidly enlarging, the last inflated; aperture rounded, lunate. Columella slightly and regularly arched. The peristome thin, straight, acute.

Mr. Cuming informs me, that when he poured boiling water on them, to kill the animal, the animal, in attempting to return within the shell, burst it, from being so much larger than the shell itself; in consequence he was compelled to drown the animal and let it remain in the water until it was half putrid, by which means

he was able to procure sound shells. He tried it several times, and destroyed some hundreds of shells before resorting to the latter means.

I may observe, that the animal in spirits does not give one the impression of being so large, compared with the shell, as the above description would imply; but, like the *Succineæ*, *Vitrinæ* and other genera, these animals appear to have the faculty of absorbing a quantity of moisture and of inflating their bodies and making them appear of a large size, and when suddenly killed they have not the power of lessening it, but while alive they certainly have. During dry and perhaps cold weather they expel the air and water, and so contract their bodies, that they can be withdrawn a considerable distance within the cavity of the shell. I have often seen this œconomy in the amber snails, *Succineæ*, and the shield shells, *Vitrinæ*, and Professor Nilsson has observed the same fact with regard to the latter genus, as quoted by me (Gray, Turton Man. 119).

The type of the genus is *Pfeifferia micans*.

Helix micans, *Pfeiffer, Proc. Zool. Soc.* 1845, 71; *Monogr. Helic.* ii. 24.
Corasia micans, *Albers, Heliceen*, 111.
Nanina Albaiensis, *Gray, Ann. & Mag. N. H.* 1853, p. 331, teeth.
Hab. Luçon.

Mr. Cuming observed it in the greatest abundance on the leaves of bushes at St. Jauno, in the province of Cagayan, at the extreme north part of the island of Luçon.

Dr. Albers refers the species to his subgenus *Corasia*, consisting of Helices with large reflected peristomes; the shells have some resemblance to the young imperfect specimens of some species of that genus, as *Helix Albaiensis*, but they differ from them in the pillar lip being evenly arched and imperforate, and not straight from the axis and slightly perforated, as in their young shells it always is.

MM. Quoy and Gaimard described a land mollusk which they discovered on leaves in Tasman's Bay, New Zealand, under the name of *Limax bitentaculatus*, Voy. Astrolabe, t. 13. f. 1, 2, 3. They only found a single specimen, which, they say, they only partially examined. From this description, as the animal differed from *Limax* in so many particulars that it was impossible to keep it in that genus, I formed a temporary genus for it under the name of *Janella*, in the 4th volume of Mrs. Gray's 'Figures of Mollusca,' p. 112. I have just received from New Zealand a specimen of land mollusk which agrees with the animal described by MM. Quoy and Gaimard in so many parti-

culars, that I am inclined to believe it to be either the species they observed, or at least a second species of the same genus; and as it offers some peculiarities not noticed in their description or figure, I shall proceed to characterize the genus.

Janella.

Body elongate, convex; back rounded; tail not keeled, tapering, acute behind, without any subcaudal gland. Mantle covering the whole of the back, with a slightly raised lateral margin, leaving a rather broad space between the edge and the edge of the foot, thin, smooth, with a longitudinal groove along the centre of the back extending the whole length of the animal, and giving out branches from each side which diverge backward to the edge; in front, over the head, there is given out a short, straight, diverging branch on each side to the hinder base of the tentacles, then forked, and the two branches continued on the under edge of the mantle to the corner of the mouth; the tentacles two, arising from the front just within the edge of the mantle, and quite retractile like those of the Slugs. Aperture of respiration is a very small round foramen, with a raised edge on the right side and close to the central groove on the back, just above the aperture of reproduction. Mouth inferior, just at the end of the foot, with three tubercles in front, which are formed by the continuation of the grooves on the front of the mantle. Aperture for reproductive organs on the front part of the edge of the right side of the mantle, about one-fourth the entire length from the head.

The foot narrow, divided into three indistinctly-marked longitudinal bands, the middle band rather the widest, the lateral bands with rather distant cross grooves, most distinct on the outer edge, and with shorter marginal grooves between them, giving the edge of the foot a crenated appearance; the end of the body is suddenly more slender, with a prominence on the back just before this sudden alternation, as if the mass of the viscera were confined to the first two-thirds of the body; but this may be caused by the contraction of the animal from being in spirits.

Shell none, or at least there is no appearance of any through the skin.

Janella antipodarum.

Hab. New Zealand. Length three-fourths of an inch.

This genus is most allied to *Philomycus* (= *Tebenophorus*, Binney = *Limacella*, Blainville), with which it agrees in having a thin mantle covering the whole of the back; but it differs from it in the position of the respiratory aperture, and in the presence of

only two tentacles, which, instead of being placed on the head, as in *Philomycus* and all the other *Arionidæ* and *Helicidæ*, are placed in the front part of the mantle. All these characters induce me to regard it as the type of a new family of *Pulmonata*, which may be called *Janellidæ*.

XL.—*Notes on the Habits of Bivalve Shell-fish.*

By S. P. Woodward.

During the past summer I spent some time with Mr. Mackie at Folkestone, and being obliged to remain within-doors the greater part of each day, I collected a number of living Bivalves, and kept them in pans of salt water, to watch them at my leisure. The first species met with were *Pholas dactylus* and *candida*, whose colonies are frequent in the beach near low-water mark, wherever a clear space occurs amongst the blocks of Kentish-rag with which the shore is encumbered. The burrows of the Pholades are in black sandy mud, from which they are easily dislodged. At some spots the inhabitants have perished, but the living colonies are readily discovered by treading heavily, or striking the beach with a stick, whereupon the alarmed inmates spirt water from their burrows. The holes of the full-grown *Pholas dactylus* are distinguishable by their larger size, and the strong jets they send up; the original small orifices have been removed by the wasting of the beach, and the present openings, an inch in diameter, were once the middle of each burrow; they are rendered somewhat smaller by a layer of light-coloured mud, which fills up the space between the shell-fish and the wall of its abode. When the shell is partly exposed the Pholas still holds strongly with its great foot, which cannot be withdrawn into the shell, and resembles a piece of translucent ice.

Placed in a pan of sea water, the smaller Pholades (*P. candida*) immediately protrude their siphons, and explore the surrounding bottom with them in a remarkably worm-like manner. The young of *P. dactylus* only pushes itself about with its siphons. The branchial currents commence instantly, and never cease unless the creatures are disturbed. The force and volume of these currents are quite marvellous to those who witness them for the first time. The inhalant orifice is trumpet-shaped, and guarded with *cirri*; the exhalant is a little contracted, and in *P. dactylus* projects beyond the other. The foot completely fills the pedal orifice, allowing neither ingress nor egress to currents of water. The current which sets into the branchial siphon carries with it whatever floating particles the water contains, whilst the stream which issues from the exhalant orifice is perfectly clear. However turbid the water may be, it is soon filtered, and the same thing

happens if the water is artificially coloured with indigo; the time required depending partly on the quality of the pigment, which is sometimes so fine as to pass through the living filter. When one Pholas was disturbed by another, or incommoded by particles too large for its siphon, it closed its valves and partly retracted the siphons, making a small jet of water. If taken from the pan suddenly, the siphonal orifices closed spasmodically, so that no water could escape, and the siphons could not be withdrawn; after a moment the orifices relaxed, and the water was spirted out. The tentacular *cirri* are extremely sensitive, and contract directly they are touched, but the mantle may be divided with fine-pointed scissors, so as to show the gills, without causing any alarm to the animal, after the sphincter surrounding the foot has once been divided. It was my wish to preserve examples of each species with the siphons protruded, and to this end I allowed some to remain in stale water, thinking they would lose the power of retraction, or die extended; day after day the siphons became longer, until they were twice their proper length, the currents ceased, and at last the valves fell off by the decomposition of the mantle; but when I attempted to remove the animal, the siphons slowly contracted until completely withdrawn.

Another small *vivarium* contained a few shells from five fathoms water; including the young of the edible mussel an inch in length, *Syndosmya alba*, *Nucula nucleus*. Some others were tenanted with the common cockle, *Donax anatinus* and *Tellina solidula* and *tenuis*, obtained from the sandy shore at Denge Ness, where the sea goes out nearly half a mile, leaving a wide waste of ripple-marked sands without any trace of life, save the castings of the Annelides and an occasional dimple made by a cockle or a Donax. But of life there was plenty, as we might be sure from the flocks of gulls which retreated before us; and on exploring with our hands we found the whole beach planted with Tellens, in a vertical position, as thickly together as holes made simultaneously with the fingers. Lower down there must have been many other shell-fish; for the high-water line was strewn with Mactras and *Cardium echinatum*, *Solen marginatus* and *ensis*, spawn of *Natica* and whelk, &c. The common cockle is an excellent subject for observation on account of its activity, the beauty of its fringed siphons, and the whirlpools it creates in the water. *Donax* has short siphons, with foliaceous cirri; *Tellina* and *Syndosmya* have very long siphons, sometimes four or five times as long as the shell, very slender and transparent, with simple orifices. Those Tellens and Donaxes which were allowed sea-sand soon buried themselves, protruding only their siphons. In a short time the sand in which they were buried became so firm that it required

some force to move it with the fingers. On changing the water, small holes would appear in the sand, from which afterwards the siphons of the Tellens were protruded. These holes were in pairs, and about the tenth of an inch in diameter; one was a little funnel, into which the grains of sand kept sliding, the other a miniature crater of sand. After the siphons were extended, they frequently bent them down and explored the surface, being evidently dissatisfied with their circumstances. Slender as the branchial siphon is in *Tellina* and *Syndosmya*, it frequently attracts particles too large to pass freely, and which after oscillating for an instant halfway down, are suddenly expelled with a jerk. Besides watching the Bivalves, we sketched them whilst living, and dissected them—or at least cut them up in every possible way—when dead, and examined them with the microscope. Everything we saw confirmed the accuracy of the account given by Messrs. Alder and Hancock in the 'Ann. Nat. Hist.'

XLI.—*Centuries of North American Fungi.* By the Rev. M. J. Berkeley, M.A., F.L.S., and the Rev. M. A. Curtis, D.D.

It is proposed in this and a series of similar memoirs to characterise a number of new North American Fungi, which have rewarded the researches of Curtis, Ravenel, Bennett, Michener, Olney, Peters, Sartwell, Lindheimer, Wright, and other botanists. It was intended at first to publish the whole in an especial work dedicated to North American Mycology, but it was found impossible to prepare so voluminous a book as a complete account of the Fungi of the United States within any fixed time, and we have therefore thought it right to publish the multitudes of new species which exist in our Herbaria by way of Prodromus, trusting that the larger work may not be put off to the Greek Calends. We ought to observe that a considerable portion of Mr. Ravenel's specimens were accompanied by copious notes, of which we have constantly availed ourselves. Indeed his name might almost uniformly have been associated with our own, were it not for the inconvenience of giving three authorities for each new species.

1. *Agaricus* (Amanita) *polypyramis*, n. s. Pileo expanso nitido areolato verrucis centralibus crassis pyramidatis; stipite radicante, basi incrassato squamuloso, lamellis attingentibus. Curt. no. 2854. In thin woods, Nov., South Carolina.

Pileus 6 inches across, pure white, shining, areolate, beset with thick, rather small, pointed pyramidal warts, especially in the centre. Stem 6–8 inches high, 1–2 inches thick, solid, incras-

sated and rooting below, almost smooth with the exception of a few little narrow transverse scales. Ring broad, evanescent. Gills white, reaching the stem, quite linear at the extremity. Odour strong alkaline.

A remarkably fine species, differing from *A. nitidus* in its nearly smooth rooting stem, the base of which is much swollen, but by no means margined. It resembles also *A. Vittadini*.

2. *Agaricus* (Amanita) *monticulosus*, n. s. Pileo convexo areolato; verrucis marginalibus floccoso-pyramidatis, centralibus pyramidatis truncatis; stipite squamoso flocculento; lamellis liberis remotis. Curt. no. 2829, 2853. In moist and sandy woods, Sept., Nov., South Carolina.

Pileus $2\frac{1}{2}$–3 inches across, convex, areolate, with a wart in the centre of each areola; those towards the margin consisting of soft threads meeting in a point, but sometimes simply flocculent, the central warts angular, pyramidal, truncate, discoloured. Stem bulbous, scaly, flocculent, white; veil thick, at length distant. Gills free, ventricose, remote, forming a well-defined area round the top of the stem.

The warts are not hard and rigid as in *A. nitidus*, and the free remote gills separate it from that and the neighbouring species. The specimen from a sandy wood has the characters far less strongly marked than the others, in which the greater part of the margin appears at first to be flocculent.

3. *A.* (Lepiota) *cultorum*, n. s. Parvus; pileo hemispherico umbonato squamis granuliformibus exasperato; stipite brevi furfuraceo, annulo subcentrali; lamellis latis remotis; sporis utrinque acutiusculis. Curt. no. 2826. Among gourds in cultivated lands, July, South Carolina.

Pileus 1 inch or more across, hemispherical, umbonate, the border sometimes repand, clothed with very numerous brown granular scales. Stem $\frac{1}{2}$–1 inch high, 1 line thick, furfuraceous. Ring nearly central. Gills broad, ventricose, free, remote. Spores cymbiform, rather acute at either extremity, about $\frac{1}{2000}$ of an inch long.

A very pretty little species allied to *A. cristatus*, from which it is readily known by its oblique spores which are nearly three times as long. Perhaps it is really more closely allied to *A. acute-squamosus*, Weinm., which has far larger spores than *A. cristatus*, though not so large as this species.

4. *Agaricus* (Lepiota) *floralis*, Berk. & Rav. MSS. Pusillus, pileo plano, squamis floccosis brunneis vestito; margine striato; stipite gracili deorsum attenuato pileo concolore; annulo medio persistente; lamellis candidis tenuibus distantibus ventricosis liberis. Rav. no. 1011. On earth in gardens, South Carolina, July, H. W. Ravenel, Esq.

Pileus $\frac{1}{2}$–$\frac{3}{4}$ of an inch across, plane, membranaceous, covered with brownish floccose scales; margin striate. Stem $\frac{3}{4}$–1 inch high, not $\frac{1}{2}$ a line thick, of the same colour as the pileus, attenuated downwards. Ring persistent, situated about the middle of the stem. Gills white, broadly ventricose, distant, free. Spores white, $\frac{1}{2300}$ of an inch long.

Closely allied to *A. fulvaster*, of which it has exactly the habit, but it has not the same bright colour, nor are the gills thick. It is still nearer to *A. cultorum*, but the plane and not hemispherical head and slender stem give it a very different appearance, and the colour is much more dingy in the dry plant. The spores vary very much in size, but we have seen none so long in this species as in *A. cultorum*.

5. *Agaricus* (Lepiota) *fulvaster*, n. s. Parvus; pileo plano-convexo candido e velo fulvo squamoso-maculato; margine striato-sulcato plicatoque; stipite gracili glabro sursum annulato; annulo fulvo; lamellis attingentibus distantibus crassiusculis candidissimis. Curt. no. 2550. Amongst grass in sandy soil, July, South Carolina.

Gregarious. Pileus 3–6 lines across, plano-convex, white, but spotted with the scaly remnants of the tawny veil; margin sulcate, sometimes splitting at the back of the gills as in *Coprinus*; centre tawny, subumbonate; substance brittle, thickish in the centre. Stem slender, nearly an inch high, scarcely $\frac{1}{2}$ a line thick, white, smooth, slightly thickened at the base, where there are a few byssoid rootlets, tough fibroso-spongy within. Ring tawny, subpersistent, situated about the middle of the stem. Gills ventricose, not crowded, attached to a distinct collar, which is not however separate from the stem, rather thick, of a pure white; margin even or slightly eroded.

A small but extremely elegant species allied to *A. seminudus*, Lasch.

6. *Agaricus* (Collybia) *Texensis*, n. s. Connato-cæspitosus; pileis glabris subcampanulatis fortiter umbonatis, obtusissimis carnosis albidis, stipite spadiceo velutino; lamellis latis ventricosis sinuato-adnatis candidis. Curt. no. 3162. Texas, C. Wright.

Connato-cæspitose. Pilei 2 inches or more across, carnose, subcampanulate or expanded, very strongly umbonate, extremely obtuse, dingy white. Stems 3 inches high, $\frac{1}{4}$ of an inch thick, of a rich brown velvety. Gills broad, ventricose, white, sinuated behind, slightly adnate.

Allied to *A. pudens*, but differing evidently in habit and in the smooth pilei.

7. *Agaricus* (Collybia) *detersibilis*, n. s. Gregarius; pileo plano umbilicato albido subfuligineo; margine striatulo; stipite solido pruinoso pileo concolori; lamellis adnatis albidis. Curt.

no. 3202. From the roots of grass in sandy soil, Aug., South Carolina.

Gregarious, subcæspitose. Pileus ½–1 inch across, plane, umbilicate, smooth, dull white with a faint brownish tinge, margin slightly striate. Stem 1 inch or more high, 1 line thick, of the same colour as the pileus, solid, somewhat twisted, compressed and enlarged above, covered with a white meal which is easily rubbed off, downy at the base. Gills crowded, adnate, very narrow, whitish.

Allied to *A. atratus*, like which it is intermediate between *Omphalia* and *Collybia*.

8. *A.* (Mycena) *iocephalus*, n. s. Pileo e convexo plano carnoso-membranaceo sulcato violaceo; stipite pallido farinaceo basi villoso; lamellis distantibus adnatis angustis undulatis, pileo pallidioribus venoso convexis. Curt. no. 2549. Amongst rotten leaves in dried swamps, Aug., South Carolina.

Odour strong and offensive. Pileus ½–1½ inch broad, convex, then plane, sulcato-striate, carnoso-membranaceous, dry, pale violet-purple. Stem 1½–2 inches high, 1–2 lines thick, fistulose, pale, farinaceous; base incrassated, villous. Gills distant, attached, unequal, sometimes forked, rather narrow, somewhat undulated, interstices venose. Spores white.

A very elegant species, distinguished from all the strong-scented Mycenæ by its farinaceous stem and general appearance.

9. *A.* (Omphalia) *centenarius*, n. s. Valde cæspitosus; pileo conico convexo umbonato fragili sulcato; stipitibus fistulosis deorsum tomentoso-connatis, lamellis longe decurrentibus. Curt. no. 2888. On rotten logs, October, South Carolina, H. W. Ravenel, Esq.

Growing in dense clusters. Pileus ½ an inch across, fragile, very thin, conical, convex, umbonate, whitish; margin coarsely striate. Stems very slender, 3–4 inches or more high, whitish hyaline, annularly mottled, fistulose, the cavity expanding above the gills, tapering and darker at the base, where they adhere by short white down. Gills white, arched, strongly decurrent.

This has just the habit of *A. tintinnabulum* and *A. myriadeus*, but has the characters of *Omphalia*.

10. *Agaricus* (Pleurotus) *Micheneri*, n. s. Cæspitosus; pileo infundibuliformi tenui luteo-albo; stipite solido gracili albo; lamellis distantibus angustis decurrentibus compositis pallide luteis. Curt. no. 3480. On decayed wood, Pennsylvania, Dr. Michener.

Cæspitose. Pileus ¾ of an inch across, infundibuliform, thin, yellowish white. Stem 2 inches high, about a line thick, white. Gills distant, compound, narrow, decurrent, pale yellow.

Allied to *A. lignatilis*.

11. *A.* (Pleurotus) *facifer*, n. s. Cæspitosus, phosphoreus, fusco-flavus; pileo tenui convexo subumbilicato; stipite subcentrali solido fibroso albido-pruinoso; lamellis angustis compositis decurrentibus. Curt. no. 3503. Pennsylvania, Dr. Michener.

Cæspitose, phosphorescent, brownish-yellow. Pileus 3 inches across, thin, convex, at length expanded, slightly umbilicate. Stem 5 inches or more high, $\frac{1}{3}$ of an inch thick, subexcentric, fibrous, slightly pruinose. Gills narrow, compound, decurrent. Spores white.

A highly curious species with the habit of *A. illudens*.

12. *A.* (Naucoria) *argillosus*, n. s. Pileo firmo convexo pallide fusco-luteo; stipite cavo deorsum attenuato albo; lamellis angustis adnexis ex albo argillaceis. Curt. no. 2908. On earth in woods, Oct., South Carolina, H. W. Ravenel, Esq.

Pileus 2–3 inches across, convex, subcoriaceous when dry, smooth, firm, of a light brownish yellow. Stem 4 inches high, $\frac{1}{2}$ inch thick, firm, cartilaginous, white, hollow, rooting, attenuated downwards. Veil none. Gills white, very numerous, narrow, slightly attached, at length discoloured from the very copious pale argillaceous, elliptic, subcymbiform, rather minute spores.

Agreeing with *A. Cucumis* in the inflected margin. The colour of the spores is purely argillaceous. We cannot point out however any species closely allied. The general appearance is that of *A. carnosus*. The spores are most copious, and when moistened feel very glutinous.

13. *A.* (Naucoria) *Curcuma*, n. s. Pileo hemispherico fusco-luteo, e floccis fasciculatis brevibus frequentissime squamuloso; carne lutea; stipite solido fusco fibrilloso; lamellis ventricosis emarginatis subadnatis ferrugineo-ochraceis. Curt. no. 2913. On an old stump, Nov., South Carolina, H. W. Ravenel, Esq.

Pileus $\frac{3}{4}$ inch across, hemispherical, dark brownish-yellow, densely covered with squamose fascicles of flocci. Flesh thin, yellow. Stem brown, 1–1$\frac{1}{2}$ inch high, $\frac{1}{4}$ line thick, solid, fibrillose, but not scaly, dilated at the base. Gills broad, ventricose, irregular, emarginate, slightly attached, dark ochraceous. Spores dark ferruginous. Mycelium tawny.

A very beautiful species allied to *A. erinaceus* and *siparius*, but the colours are different, the stem is solid and not clothed like the pileus, and the gills are emarginate.

14. *A.* (Galera) *crocosporus*, n. s. Pileo membranaceo e conico convexo, demum depresso viscido sordide fusco expallente sulcato; stipite albo sericeo-nitente; lamellis breviter adnatis e pallidis ferrugineo-crocatis. Curt. no. 2867. On a damp house-mat, Aug., South Carolina, H. W. Ravenel, Esq.

Gregarious. Pileus an inch or more across, membranaceous,

fragile, at first conical, then convex, and finally depressed, viscid, sordid brown, margin marked with prominent folds, rugose in drying, the apex however remaining even. Stem 3–4 inches high, slender, white with a silky lustre, fistulose, thickened at the base. Veil none. Gills numerous, regular, shortly adnate, ventricose, light ferruginous, at length saffron-yellow from the spores. Spores large, elliptic, subcymbiform.

This species belongs to the same group as *A. Ruderum*, but differs from all in its sulcate pileus and bright saffron-yellow spores.

15. *Agaricus* (Crepidotus) *nephrodes*, n. s. Pileo reniformi pallide flavido-tomentoso; stipite obsoleto; lamellis ventricosis pileo concoloribus. Curt. no. 1912. On damp rotten logs, South Carolina, H. W. Ravenel, Esq.

Gregarious, sometimes imbricated. Pileus 1 inch or more across, thin, suborbicular, reniform or subspathulate, plane, clothed with a dingy yellowish-white down; margin inflected, flesh-white. Stem sometimes quite obsolete, but when present very short. Gills pale like the pileus, gradually attenuated behind. Spores globose, rosy ferruginous.

This curious species has the habit of *A. petaloides*, especially of North Carolina specimens, but differs materially in the coloured spores, not to mention other points.

16. *Hiatula fragilissima*, Rav. MSS. Pileo plano subumbonato radiatim fisso marginibus rimarum luteo-pulverulentis interstitiis candidis; stipite luteo farcto; annulo mobili; lamellis remotis. Curt. no. 2899. On earth and decayed vegetables on the margin of swamps, H. W. Ravenel, Esq., July.

Solitary or gregarious. Pileus 2–3 inches across, plane, very thin and fragile, membranaceous, subumbonate, plicate, the edges of the folds covered with yellow dust, deepening in colour towards the centre, interstices white; umbo darker, slightly viscid. Stem 4–6 inches high, slender, somewhat bulbous, covered with white down at the base, yellow, very fragile, fistulose, the cavity stuffed with cottony fibres. Ring moveable. Gills white, thin, and membranaceous, rather distant, ending abruptly at the margin of a smooth area surrounding the top of the stem. Spores white, obliquely elliptic, rather large.

This, together with *A. discretus*, *A. Benzonii*, and one or two species from Brazil, form the genus *Hiatula* of Fries, which is at present unpublished. The outward resemblance of the species to *Coprinus plicatilis*, especially when dry, is very strong, though the more intimate characters are very different. The spores of *C. plicatilis* are much larger and broader, besides being very dark.

**Montagnites Candollei*, Fr. Ep. p. 241, var. *Texensis*; minor stipite transversim squamoso; sporis paullo majoribus. Curt. no. 3917. On sandy ground, Texas, C. Wright.

Stem 4½ inches high, ¼ of an inch thick, attenuated above and below, transversely squamose. Pileus 1 inch broad, spores rather larger than in the European and Algerian form.

It is possible that permanent characters might be detected in the plant when fresh, but we can see no other differences in the dried specimens than those pointed out above.

17. *Cortinarius* (Myxacium) *iodes*, n. s. Minor; pileo carnoso e convexo plano firmo violaceo-purpureo; carne alba; stipite solido tenui deorsum incrassato; lamellis e violaceo-cinnamomeis adnatis subemarginatis. Curt. no. 2895. Amongst moss and roots, Sept., South Carolina, H. W. Ravenel, Esq.

Cap 1½–2 inches across, convex, at length plane, viscid, firm, violet-purple; flesh thick, white. Veil fugacious, arachnoid. Stem 2–3 inches high, ½ an inch thick, solid, incrassated below. Gills violet, at length cinnamon, ventricose, adnate, subemarginate, irregular, sometimes forked.

Allied to *C. Salor*, but a smaller species and more brightly coloured.

18. *Paxillus solidus*, Rav. MSS. Pileo pulvinato rufo-fusco subtomentoso; stipite solido glabro, lamellis latis distantibus decurrentibus e cinereo-maculatis fuscis, postice anastomosantibus. Curt. no. 2884. In pine woods on the burnt ground, July, South Carolina, H. W. Ravenel, Esq.

Pileus 2–3 inches across, pulvinate, fleshy, at length plane in the centre, light reddish-brown, dryish, subtomentose; margin at length inflexed. Stem 2–3 inches high, ½ an inch thick, solid, smooth. Gills at first dingy cinereous and mottled, at length brown, broad, distant, decurrent, anastomosing and forming pores at the base. Spores elongated like those of a *Boletus*.

Distinguished from one or two somewhat similar species by its elongated spores which indicate a close affinity between the two genera.

19. *Paxillus Curtisii*, Berk. MSS. Sessilis imbricatus; pileis subreniformibus sulphureis pulveraceo-tomentosis; lamellis aurantiacis antice furcatis postice anastomosantibus, lateribus interstitiisque plicato-venosis fusco-atris. Curt. no. 1985, 2000, 2877. On pine logs, Upper Georgia and South Carolina, H. W. Ravenel, Esq.

Densely imbricated; pilei varying from 1–3 inches across, mostly reniform, sometimes slightly elongated, stemless, sulphur-coloured, umber-brown when dry, inclining to rufous pulverulento-tomentose; margin incurved. Substance tawny. Gills orange, then reddish-brown, black when dry, forked in front and then obtuse plicato-venose on the sides and interstices. Spores minute, ochraceous, rather oblong.

This at first sight resembles *P. panuoides*, but the gills are

more plicate, forked in front, and their spores far more minute. The substance also is of a brighter colour, as indeed is the whole plant. The gills are much like those of a *Cantharellus*.

20. *Paxillus reniformis*, Berk. and Rav. MSS. Pileo reniformi dense tomentoso brunneo-pallido; stipite obsoleto; lamellis latissimis primum albidis demum e sporis brunneo-ferrugineis. Rav. no. 1508. On oak rails, Sept., Sulphur springs, North Carolina, H. W. Ravenel, Esq.

Subimbricated. Pileus 1–3 inches across, light brown, reniform, densely tomentose. Stem obsolete; gills very broad, at first whitish, at length discoloured by the subferruginous broadish spore.

This species has somewhat the habit of *P. panuoides*, but differs in the nature of the pileus and the differently coloured gills.

21. *Hygrophorus hæmatocephalus*, n. s. Pileo convexo umbilicato sanguineo; stipite cavo compresso subrubro; lamellis crassis adnatis flavis. Curt. no. 2893. On the ground in pine woods, Aug., South Carolina, H. W. Ravenel, Esq.

Pileus 1–2 inches across, fleshy, brittle, convex, umbilicate, blood-red. Stem 1–2 inches high, $\frac{1}{2}$–2 lines thick, attenuated downwards, brittle, hollow, compressed, reddish above, becoming pale or yellow below. Gills ventricose, adnate, broad, thick, irregular, yellow, interstices even. Spores white, elliptic.

Allied to *H. cinnabarinus*, but differing in colour, in the adnate, not truly decurrent gills, and in the more regular, much larger spores. The hymenium in large specimens, when dry, has exactly the appearance of that of *Peziza aurantiaca*. A variety of *H. cinnabarinus* occurs with strongly veined interstices.

22. *Hygrophorus nitidus*, n. s. Pileo convexo umbilicato viscoso e flavo pallescenti; stipite fistuloso viscido; lamellis flavis decurrentibus. Curt. no. 2878. On earth in damp swamps, Sept., South Carolina, H. W. Ravenel, Esq.

Pileus $\frac{1}{2}$–1 inch across, convex, umbilicate, brittle, viscous or humid, dark yellow, paler in drying; substance very thin. Stem 3–4 inches long, slender, viscid, dilated above, of the same colour as the pileus, fistulose. Gills yellow, arched and ventricose, decurrent, interstices venose. Allied to *H. Cantharellus*, Fries. In colour, though darker, it resembles *H. ceraceus*, but the habit is very different, and the gills more decidedly decurrent.

23. *Hygrophorus Ravenelii*, n. s. Cæspitosus subcarnosus; pileo convexo humido aurantio glabro; carne flava; stipite fragili fistuloso flavo deorsum candido; lamellis emarginatis ventricosis pileo dilutioribus. Curt. no. 2889. On the earth in damp places, Sept., H. W. Ravenel, Esq.

Cæspitose. Pileus $1\frac{1}{2}$–$2\frac{1}{2}$ inches across, convex, smooth, moist, orange-red; flesh very thin, yellow. Stem 4–5 inches high,

$\frac{1}{4}$ inch thick, fistulose, brittle, yellow, whitish and attenuated below. Gills paler than the pileus, ventricose, deeply emarginate, but attached. Spores white.

This species is apparently most nearly allied to *H. puniceus*, but differs in the form of the pileus, which is extremely thin, and the slender tall equal stem.

24. *Lactarius illachrymans*, Berk. and Rav. MSS. Parvus; pileo e convexo plano umbilicato zonato pallide fulvo; stipite solido albo; lamellis albidis subdecurrentibus. Rav. no. 1306. In swamps, South Carolina, Sept., H. W. Ravenel, Esq.

Small. Pileus 1–$1\frac{1}{2}$ inch across, thin, plane, at length umbilicate, pale tawny, with two or three darker concentric zones. Stem 1–2 inches high, about 2 lines thick, solid, white. Gills dingy white, crowded, narrow, subdecurrent, not discharging any milky fluid when broken; taste slightly aromatic, pungent.

The warmer states of North America abound with *Lactarii* quite different from the European species, but though we have many in our Herbarium, as in most instances notes were unfortunately not secured from the living specimens, we are obliged for the present to delay their publication.

25. *Cantharellus Ravenelii*, n. s. Pileo irregulari subinfundibuliformi lento innato-fibroso luride flavo; stipite solido tomentoso albo; venis lamelliformibus luteis, decurrentibus, omnibus una desinentibus. Curt. no. 2879. On decayed logs, Aug., South Carolina, H. W. Ravenel, Esq.

Tough. Pileus 1–2 inches broad, irregular, subinfundibuliform, innato-fibrous, of a pale dull yellow; margin more or less undulated, subtomentose. Stem 1–2 inches high, about 2 lines thick, firm, solid, white, tomentose, thicker below. Veins lamellæform, bright yellow, branched, decurrent, but ending abruptly, their edge obtuse; interstices for the most part even. Spores white.

This very curious species approaches somewhat in characters to the genus *Panus*, but the edge of the lamellæform veins is obtuse.

26. *Cantharellus flabelliformis*, Berk. & Rav. MSS. Albidus; pileo membranaceo e stipite brevi laterali flabelliformi 2–3 sulcis concentricis notato tomentoso; venis furcato-anastomosantibus superficialibus. Rav. no. 1313. On fallen trunks, South Carolina, H. W. Ravenel, Esq.

Whitish ochraceous when dry. Stem 2 lines high, 1 thick, lateral, short, compressed or subcylindrical, tomentose. Pileus $\frac{1}{2}$ an inch or more long, membranaceous, spathulato-flabelliform, sometimes forked, tomentose, like the stem marked with two or three concentric furrows. Hymenium bordered. Veins shallow, forked, anastomosing.

A most curious and distinct species, with the habit of *Panus stypticus*. The hymenium is distinct from the stem and bordered

as if the stem were merely an elongation of the vertex. The nearest ally is perhaps *C. crispus*.

27. *Marasmius dichrous*, n. s. Pileo subtiliter tomentoso subvelutino fusco; stipite furfuraceo basi subdilatato; lamellis liberatis. Curt. no. 2834. On rotten wood in dry swamps, South Carolina.

Pileus 1 inch or more across, convex, dark brown, clothed with close matted down, sometimes appearing velvety. Stem 1–1½ inch high, scarcely a line thick, brown, clothed with furfuraceous down; base slightly dilated, villous. Gills at first adnate, separating from the stem, and sometimes leaving a naked area round it, moderately distant, ventricose; interstices nearly even. Spores white.

Nearly allied to *M. ramealis*. It is however a larger species, and remarkable for its dark brown pileus.

28. *Marasmius pusio*, n. s. Pusillus; pileo membranaceo fusco-purpureo striatulo; stipite gracili subtiliter tomentoso opaco; lamellis adnatis crebris ventricosis albidis. Curt. no. 2043. On the bark of trees, summer and early autumn, South Carolina, H. W. Ravenel, Esq.

Pileus scarcely more than a line broad, membranaceous, regular, slightly convex, pale purple-brown, delicately striate, opake, very minutely pulverulent. Stem 8–10 lines high, very slender, whitish, obscurely tomentose or pulverulent. Gills moderately broad, numerous, ventricose, adnate, dirty white.

A minute species, resembling somewhat *Marasmius graminum*, but not very closely allied. The surface of the pileus resembles that of such species as *M. ferrugineus*, the stem however is more like that of *M. opacus* or *M. spongiosus*.

29. *Marasmius brevipes*, Berk. & Rav. MSS. Pileo convexo estriato atro-sanguineo; stipite brevi filiformi aterrimo nitido e myccelio repente similari enato; lamellis paucis adnatis rufis. Rav. no. 1527. On dead twigs of oak, June, Santee Canal, South Carolina, H. W. Ravenel, Esq.

Pileus 1–2 lines broad, convex, dark blood-red; margin even; stem filiform, jet-black, quite smooth, 1–2 lines high, springing from creeping mycelioid threads of the same nature with itself; gills ventricose, few, adnate, rufous.

Allied to *M. hæmatocephalus*, &c., but distinguished at once by its short polished stem and dark gills. The colour of the pileus is nearly that of *M. atrorubens*.

30. *Lentinus parvulus*, n. s. Cæspitosus; pileo submembranacco infundibuliformi glabro, margine revoluto; stipite gracili lanuginoso; lamellis angustis dichotomis decurrentibus albis. Curt. no. 3624. On decayed wood, Pennsylvania, Dr. Michener.

Cæspitose. Pileus ¾–1 inch across, membranaceous, irregular,

infundibuliform, smooth, dirty white; margin finely revolute; stem 1 inch high, not a line thick, nearly smooth above, lanuginous, below pale brown; gills extremely narrow, entire, often dichotomous, white, strongly decurrent. Spores white.

An elegant little species, and quite a dwarf in a genus containing many of the most magnificent fungi.

31. *Lentinus Micheneri,* n. s. Pileo sinuato sublobato umbilicato glabro; stipite brevi incurvo spongioso-velutino fusco; lamellis latiusculis laceratis crassis breviter decurrentibus. Curt. no. 3962. On decaying timber, Pennsylvania, Dr. Michener.

Pileus about 2 inches across, irregular, lobed and sinuated, umbilicate, smooth; stem about 1 inch high, 2 lines or more thick, clothed with brown spongy down, but more especially below; gills rather thick, broadish, shortly decurrent.

A very distinct species, to which we can point out no close ally. The gills resemble those of *L. cochleatus.*

32. *Lentinus pallidus,* n. s. Cæspitosus; pileo convexo margine repando sordide luteo-albo; stipite fibroso-squamoso deorsum furfuraceo, lamellis decurrentibus crassiusculis. Curt. no. 2586. On dead wood, South Carolina, H. W. Ravenel, Esq.

Cæspitose, connate at the base. Pileus 3-4 inches broad, convex, slightly depressed in the centre, dingy yellow-white, margin repand; stem 4 inches high, $\frac{1}{4}$ of an inch or more thick, rough above, with a few coarse squarrose fibres, furfuraceous below. Gills white, decurrent, lacerated, interstices venous. Spores white.

Allied to *L. lepideus,* but the pileus is quite smooth, and the stem rough with linear processes torn from its substance.

33. *Panus levis,* n. s. Pileo plano-depresso villoso, stipite sursum attenuato tomentoso deorsum strigoso pallidis; lamellis latis distantibus integris deorsum villosis. Curt. no. 2949; Rav. no. 808. On trunks of trees, Sept., H. W. Ravenel, Esq.

Pileus 3 inches across, orbicular, slightly depressed, white, clothed in the centre with long intricate villous rather delicate hairs, which are shorter and more matted towards the inflected margin. Substance rather thin. Stem 3 inches high, $\frac{1}{2}$ an inch thick, attenuated upwards, generally excentric, sometimes lateral, not rooting, solid, strigose below, closely villous like the margin of the pileus above. Gills rather broad, entire, decurrent, but not to a great degree; the interstices even above, behind clothed with the same coat as the top of the stem. Spores white.

A most distinct species, remarkable for its great lightness when dry, and the long, villous, but not compressed or compound, flocci of the pileus. Sometimes the centre of the pileus becomes quite smooth when old.

34. *Panus alliaceus,* n. s. Pileo sessili postice subeffuso al-

bido-fulvo subtiliter tomentoso, margine hispidulo scabriusculo involuto; lamellis subdistantibus postice attenuatis concoloribus. Curt. no. 2862; Rav. no. 1349. On the putrescent stumps apparently of *Nyssa*; also on *Salix nigra*, H. W. Ravenel, Esq.

Smell strong alliaceous, highly offensive. Pileus 2 inches or more across, stemless, suborbicular, at length slightly elongated, minutely tomentose behind, more distinctly so in front, where it is sometimes rather scabrous and hispid, dirty white inclining to tawny or yellow, especially towards the edge; often more or less effused behind. Gills of the same colour as the pileus, distant, entire, moderately broad, attenuated behind, interstices even. Spores white with a very slight yellow tinge, minute, oblong, strongly curved.

A fine species, apparently allied to *P. fœtens*, but without the least trace of a stem. The curved spores are very remarkable. In the young plant the pileus is nearly resupinate.

35. *Xerotus lateritius*, n. s. Pileo sessili reniformi convexo lateritio; lamellis paucis atro-fuscis. Curt. no. 2563. On damp decayed logs, Dec., Santee Canal, South Carolina, H. W. Ravenel, Esq.

Solitary. Pileus reniform, attached by a little down, convex, deep brick-red, $\frac{1}{4}$ of an inch across; margin involute. Stem obsolete. Gills few, dark brown, radiating from the point of attachment.

Resembling *X. nigrita*, Lév., but distinguished at once by its brick-red pileus. Dr. Léveillé has sent us either the same or a closely allied species which he received from the southern part of Chili.

**Xerotus nigrita*, Lév., Ann. d. Sc. Nat. Feb. 1846, p. 120; Curt. no. 2868; Rav. no. 892, 917. On fallen trunks of *Laurus Caroliniensis*, *Rhus toxicodendron*, and *Rhus radicans*. South Carolina, Feb.–May, H. W. Ravenel, Esq.

Tawny or brownish when dry; there is a very short lateral stem, as is also the case in Dr. Léveillé's authentic specimens from Manilla, gathered by Perrotet. This at first resembles *A. niger*, Schwein., but is in reality very different.

Apparently a distinct species, strongly grooved and thinner than *X. nigrita*, occurs on dead stems of Vine, no. 1975, but unfortunately perfect specimens have not at present been gathered.

36. *Lenzites rhabarbarina*, n. s. Fulvo-rhabarbarina; pileo sessili reniformi sulcato-zonato rugoso spongioso velutino; margine acutiusculo; lamellis dentatis subsinuatis. Curt. no. 3849. On pine stumps, South Carolina.

Pileus $1\frac{1}{2}$ inch across, scarcely $\frac{3}{4}$ inch long, of a rich tawny, inclining in parts to rhubarb-yellow, sessile, reniform, rather thin, coriaceous, marked with two or three irregular furrows, and rough

with little radiating elevations, clothed with matted down, which in the younger part appears velvety, in the older spongy. Gills moderately distant, toothed, somewhat sinuated, rhubarb-coloured.

Very distinct from every form of *L. abietina* and *L. sæpiaria*, and approaching somewhat to *L. cinnamomea*, Fr., and still more closely to *L. subferruginea*, Berk., but its bright colours are very peculiar, which added to its grooved and corrugated surface and somewhat sinuated toothed gills readily distinguish it.

37. *Boletus Curtisii*, Berk. MSS. Pileo convexo viscosissimo aureo-luteo; stipite inæquali exannulato cavo stramineo; poris subliberis demum fulvis. Curt. no. 3212. On the earth in pine woods, South Carolina.

Pileus 1 inch or more across, convex, subhemispherical, golden yellow, clothed with a very viscid pellicle; stem irregular, unequal, hollow, ringless, 2–3 inches high, $\frac{1}{4}$ of an inch thick, pale or straw-coloured; pores hollowed out at their junction with the stem, nearly free, at length fulvous. Spores subelliptic, slightly attenuated at either end, ferruginous yellow.

A very beautiful and distinct species, as are several from the southern United States. Some of these are now characterized, but we are obliged to omit some very curious forms for want of more perfect notes.

38. *Boletus Ravenelii*, n. s. Pileo e convexo plano juniori viscidulo, pulvere læte sulphureo (veli vestigiis) vestito; carne albida; stipite tenui velo flocculento pulveraceo sursum in annulum fugacem contextum operto; poris flavis adnatis, tactis virescentibus. Curt. no. 1970. *B. sulphureus*, Rav. MSS. no. 810. In pine woods on the ground, July, South Carolina, H. W. Ravenel, Esq.

Solitary. Pileus 2 inches across, convex, at length plane, somewhat viscid when young, covered with a bright yellow powder the remains of the veil; flesh whitish, unchanging, tasteless. Stem 3 inches high, $\frac{1}{4}$–$\frac{1}{3}$ of an inch thick, solid; veil arachnoid, covered with dust, which stains the stem as well as the cap, forming a fugacious ring. Pores adnate, roundish and angular, large, yellow, changing to greenish when bruised. Spores ochraceous, elliptic, containing sometimes a single globose nucleus.

A most splendid species closely allied to *B. hemichrysus*, and, like that, remarkable for the pulverulent veil.

39. *Boletus hemichrysus*, n. s. Pileo nitide aureo rivuloso floccoso pulvere flavo insperso; stipite brevi e flavo-rufescente; tubis adnatis subdecurrentibus spadiceis. Curt. no. 2928. Attached to roots of *Pinus palustris*, H. W. Ravenel, May, June.

Pileus 6–8 inches across, convex, at length plane or irregularly depressed, very bright golden-yellow, squamuloso-floccose,

disposed to crack, sprinkled with copious yellow dust. Flesh yellow, tasteless. Mycelium yellow. Stem short, varying in thickness, sometimes 1½ inch in diameter, yellowish tinged with red, irregular, contracted below. Veil none. Hymenium rich red-brown. Tubes angular, adnate, slightly decurrent. Spores ochraceous, dingy, oblong, minute.

A very splendid species, remarkable for its pulverulent pileus and habit. It resembles *B. variegatus*. The dust, it is to be observed, is not due to the presence of *Sepedonium*.

40. *Boletus decipiens*, n. s. Pileo sicco pallide flavido sub lente sericeo; carne alutacea; stipite æquali spongioso; velo floccoso; hymenio flavo, poroso. Curt. no. 1312. In thin woods, Aug., South Carolina.

Pileus 2 inches across, rather dry, minutely silky, whitish yellow or pale buff; flesh buff, ⅓ of an inch thick. Stem 2–2½ inches high, 3–4 lines thick, solid but spongy. Veil evanescent, floccose, adhering for a time to the margin. Hymenium plane or rather concave, yellow, consisting of large unequal flexuous tubes. Spores ochraceo-ferruginous, oblong, rather minute.

This is so like *Paxillus porosus*, Berk., when dry, that it is scarcely distinguishable without examining the spores, which are very different. Its affinities are however clearly with *B. flavidus* and its allies, from which it is distinguished by its large radiating pores resembling multiseptate gills.

41. *Boletus conicus*, Rav. MSS. Pileo subconico flavo-flocculento; carne alba immutabili; stipite glabro sursum attenuato; hymenio incarnato; poris minoribus. Curt. no. 2929. In damp pine woods, South Carolina, H. W. Ravenel, Esq.

Pileus 1–2 inches across, pulvinate, subconical, clothed with fasciculate adpressed yellowish flocci. Flesh white, not changing when cut, tasteless. Stem 2 inches high, ½ an inch thick, pale yellow, smooth, attenuated upwards. Mycelium white. Hymenium ventricose, flesh-coloured, at length darker from the spores; tubes small, subfimbriate, angular. Spores fusiform, subferruginous.

Allied to *B. scaber*, but differing in the fasciculato-floccose pileus, smaller tubes, and smooth stem.

**Polyporus lepideus*, Fr. Ep. p. 430; Curt. no. 3068. On dead wood, New York, Dr. Sartwell.

The stem in the American specimens is sometimes reticulate and sometimes even. The pileus is more tawny, but the whole plant agrees in other respects with an authentic specimen of this very rare species.

42. *Polyporus* (Mesopus) *persicinus*, n.s. Stipite centrali obeso pileo crasso maximo pulvinato centro depresso velutino fulvo-brunneo quandoque purpurascenti confluenti; contextu aquoso-

spongioso zonato pallido lilacino; poris parvis albidis. Curt. no. 2945; Rav. no. 1114. At the foot of trees in pine woods, June, South Carolina, H. W. Ravenel, Esq.

Pileus 8–10 inches across, thick, pulvinate, depressed in the centre, obsoletely zoned, clothed with coarse tawny-brown, fawn-coloured, or sometimes brownish-purple velvety down, heavy and watery when fresh, light and spongy when dry. Margin lobed or waved, very obtuse. Substance zoned, the zones sometimes dark like the pileus, whitish tinged with lilac. Stem short, coarse, obese, conical, confluent with the pileus, nearly 3 inches thick above. Pores small, dirty white, decurrent, dissepiments thin.

Allied to *P. tabulæformis, Schweinitzii,* &c., but at once distinguished by its whitish pores and substance. The surface of the pileus is somewhat like that of *P. resinosus.* The name alludes to the swelling coarsely velvety margin, and the pale peach-blossom hue of the substance when dry.

43. *Polyporus* (Mesopus) *flavo-virens,* Berk. & Rav. MSS. Pileo irregulari lobato subreniformi sordide flavo zonis flavo-virentibus primum notato; contextu albo; stipite centrali laterali-que; hymenio ex albo flavo-virente; poris mediis decurrentibus. Rav. no. 1490. In woods, Sept., upper part of South Carolina, H. W. Ravenel, Esq.

Pileus 3–5 inches across, irregular, more or less distorted, reniform or suborbicular, subtomentose, dirty yellow, with obscure concentric bands of greenish yellow which disappear in age; edge thin, acute; substance white. Stem 1–1$\frac{1}{2}$ inch high, $\frac{1}{4}$–1 inch thick, coloured like the pileus, solid, central or lateral. Hymenium whitish when young, in age greenish-yellow, strongly decurrent; pores middle-sized, angular, irregular, in age laccrated, passing downwards almost to the base of the stem.

This species must be placed near *Pol. rufescens,* but we can point out no closely allied species. It resembles in some respects *Pol. cristatus.* The substance, when dry, tears into fibres, but is rather tough. It is a very remarkable species.

44. *Polyporus* (Mesopus) *dependens,* n. s. Totus cinnamomeus; pileo cyathiformi vertice in stipitem gracilem cylindricum elongato striato-sericeo subzonato; poris parvis angulatis. Curt. no. 3691. On the under side of pine wood lying on the ground, South Carolina.

Pileus $\frac{1}{2}$ to $\frac{3}{4}$ of an inch across, cyathiform or turbinate, with the vertex elongated into a slender cylindrical stem $\frac{1}{4}$ of an inch high and 1 line thick, often attached by an orbicular spongy disk, tawny cinnamon, as is the whole plant, sericeo-striate, tomentose, somewhat zoned. Pores small, $\frac{1}{120}$th of an inch across, angular, edge slightly toothed.

This perhaps would more properly be placed in *Resupinati*, but the stem is very distinct, so as to make the species at first sight resemble some central-stemmed *Thelephora*, especially when the pile are proliferous, as is sometimes the case. We know of no species of which it can be a transformation, and it is well worthy of notice. The surface of the pileus resembles that of *P. radiatus*.

**Polyporus Boucheanus*, Fr. Ep. p. 438, var. *peponinus*. Pileo orbiculari depresso azono glaberrimo; stipite brevi candido leproso; poris amplis angulatis elongatis; dissepimentis rigidis acie irregulari. Curt. no. 2482. On fallen branches, South Carolina.

Pileus $1\frac{1}{2}$ inch across, orbicular, depressed, perfectly smooth, shining. Stem short, central, clothed with white leprous meal; occasionally lateral, in which case the pileus is somewhat elongated. Pores about $\frac{1}{30}$th of an inch wide, above a line long, angular, decurrent; dissepiments rigid, their edge irregular.

Differs from the normal form of *Pol. Boucheanus*, as it occurs in Ohio, in its smooth pileus. Fries speaks of the thin dissepiments, but Klotzsch does not describe them as peculiarly thin. In the Ohio and Carolina species, though not thick, they are very rigid when dry.

45. *Polyporus* (Pleuropus) *amygdalinus*, Berk. & Rav. MSS. Pileo flabelliformi carnoso sordide luteo maculato odorato; stipite obsoleto; poris parvis sinuosis irregularibus. Rav. no. 1153. On the sides of rotten oak logs, Newhope, South Carolina, H. W. Ravenel, Esq.

Subimbricated. Pileus 2–4 inches across, flabelliform, convex, carnose, dingy yellow with irregular darker patches; odour strong, like that of vanilla or almonds. Stem obsolete. Hymenium white, pores small, $\frac{1}{34}$th of an inch across, sinuous, irregular, dissepiments thin, edge toothed.

Resembling some form of *P. squamosus*, but at once distinguished by its small pores.

46. *Polyporus dealbatus*, n. s. Pileo suberoso reniformi contracto pallido zonato sericeo-striato farinaceo; contextu albo demum friabili; margine acuto; stipite definite laterali irregulari flexuoso rugoso hic illic pallide lateritio; poris minimis pallidis. Curt. no. 1524, 1949; Rav. no. 836. On the ground. South Carolina.

Pileus about 1 inch across, reniform, convex, faintly zoned in the centre, more strongly towards the margin, slightly rugose, of a very pale rufous or brown tinge, sericeo-striate, mealy as if washed over with a whitewash which gives the whole a dull appearance; margin acute, in larger specimens much contracted; substance white, powdery when scraped. Stem nearly

3 inches high, $\frac{1}{4}$ inch thick, distinctly lateral, irregular, flexuous, here and there of a very pale brick-red, mealy like the pileus, incrassated at the base. Hymenium, at least when dry, white or pale rufous; pores extremely minute.

This has the habit of *P. auriscalpium*, P., but is a totally different species and certainly undescribed. Its very minute pale pores, its friable substance like that of *P. officinalis*, and other points will readily distinguish it. The whitewashed appearance is not assumed at first. Young individuals are simply sericeo-striate. It may be stated here that *P. xalapensis*, Berk., is *P. prolificans*, Fr., and *P. Caroliniensis*, Berk. & Curt., *P. biformis*, Fr.

47. *Polyporus* (Pleuropus) *mutabilis*, n. s.* Pileo coriaceo rigido flabelliformi zonato luteo-albo, primum subtiliter sericeo striato tomentoso demum glabrescente crebrizonato deorsum in stipitem definite lateralem variæ longitudinis angustato; poris minimis albidis. Curt. no. 2256, 2858, 2859, 2943. On decayed logs, Aug., South Carolina, H. W. Ravenel, Esq.

Pileus yellowish white, coriaceous, tough and rigid, flabelliform or spathulate, $2\frac{1}{2}$ inches broad and long, but varying greatly in form and size, sometimes much elongated, at first minutely tomentose and marked with raised silky lines, at length becoming smooth, concentrically zoned, the zones often depressed; narrowed behind into a stem varying from a few lines to 3 inches, and about $\frac{1}{3}$rd of an inch thick; margin very thin, lobed. Hymenium whitish, pores very minute, punctiform, except where they are lacerated or confluent.

A very curious species nearly allied to *P. dealbatus*, but differing in many essential characters. Both occur in Cayenne, unless the specimens transmitted by Dr. Montagne have been misinterpreted. It should be remembered that in those cases where the stem is most elongated, it penetrates into the soft

* *Polyporus cervino-nitens*, Schwein.! MSS. Pileo flabelliformi tenui radiato-rugoso plicatove ligneo-coriaceo sublobato cervino-fulvo zonis crebris obscurioribus sericeo-striato, hymenio contextuque subconcoloribus dilutioribus, poris minimis. Surinam. Herb. Schweinitz.

Pileus flabelliform, 2 inches high, above 2 inches broad, thin, of a hard coriaceous substance, slightly lobed, attenuated behind into an obscure stem, radiato-rugose or plicate, sericeo-striate, of a bright tawny fawn-colour approaching to brick-red, with narrow darker zones, margin very thin. Substance and the bordered hymenium paler, pores punctiform, very minute.

A very beautiful species, confounded in our paper in the Journal of the Academy of Natural Sciences of Philadelphia, N.S. vol. ii. p. 278, with *P. modestus*, Kze, which is however very near to *P. affinis*, if the specimen in Weigelt's *Exsiccata* is rightly named.

wood, so that only about an inch can properly be called stem. Some specimens approach very near to *P. luteus*, but the pores in that species are still smaller, in addition to other differences.

48. *Polyporus* (Merisma) *Berkeleii*, Fr. "Latissimus, pileo suberoso tenui utrinque applanato longitudinaliter rugoso [subtiliter tomentoso] alutaceo, margine acuto undulato lobato, contextu porisque tenellis mollibus inæqualibus pallidioribus." Fr. Nov. Symb. p. 40. Curt. no. 547. Upper Carolina.

Yellowish white. Pilei imbricated, nearly a foot long, and more in breadth, thin in proportion to the length, marked with irregular zones and numerous radiating ridges and lines, tomentose, but not uniformly; margin thin, acute, lobed and waved. Substance $\frac{1}{2}$ an inch or more thick, contracting greatly in drying. Pores middle-sized or large from confluence, irregular, angular, sinuated, dissepiments thin.

Nearly allied to *P. lobatus*. Substance not friable as in *P. sulphureus* when dry, to some specimens of which it bears a certain resemblance, but tough and corky.

49. *Polyporus* (Merisma) *trichrous*, n. s. Cæspitoso-multiplex, succoso-caseosus, subtiliter tomentosus hic illic velutinus umbrino pallescens zonatim obscurior; contextu corneo; hymenio candido, poris minutis subæqualibus angulatis, dissepimentis integris denticulatisque. Curt. no. 2944. *P. tricolor*, Rav. no. 973. On old logs, Apr., May, South Carolina, H. W. Ravenel, Esq.

Pileus many inches broad, stemless, various, mostly dimidiate, with more or less intricate lobes, undulated, rugose, or nearly even, umber-brown, at length paler with darker bands, but not truly zoned, finely tomentose, in parts velvety; margin inflected or straight. Substance salmon-coloured, becoming white when dry, soft but very tough. Hymenium white, very slightly tinged here and there with yellow. Pores minute, $\frac{1}{60}$th of an inch across, moderately long, mostly equal, angular; dissepiments thin; edge entire or variously toothed. Smell pleasant; taste scarcely any.

This species has very much the appearance of *P. sulphureus*, differing principally in its umber-brown pileus, salmon-coloured substance, and white tubes. The substance is tough, and not friable. It seems just intermediate between *P. sulphureus* and *P. imbricatus*. We have been unable to retain Mr. Ravenel's name, as it is preoccupied by Léveillé.

50. *Polyporus* (Anodermeæ) *Halesiæ*, n. s. Pileo effuso reflexo pallido zonato, zonis obscurioribus; tomento postice subspongioso antice lineatim subfasciculato vestito; poris minutis cinereo-cervinis. Curt. no. 2027, 2028. On branches of *Halesia tetraptera*, Upper Georgia.

Pileus effused, broadly reflected, pale fawn-coloured, with one or two darker zones, clothed with rather spongy down behind, but in front radiato-striate; margin undulated, very thin. Hymenium fawn-coloured, inclining to cinereous. Pores minute, angular; dissepiments thin.

A resupinate form occurs with the margin slightly reflected, and the pores darker and smaller.

Allied to *Pol. crispus*, but very distinct.

XLII.—*Note on the Transverse Processes of the Two-toothed Dolphin* (Hyperoodon bidens). By Prof. Owen, F.R.S. &c.

Two kinds of 'transverse processes' are recognized in vertebrate skeletons answering to the parts defined by Soemmerring, in the human cervical vertebræ, as the 'radix prior, seu antica, e corpore, processus transversi,' and the 'radix postica, ex arcu, processus transversi': the so-called 'processus transversus' being now known to consist of a rudimental rib (pleurapophysis) confluent with the process from the body and the process from the arch. Such processes are more developed and better defined in the lower animals, where, instead of being 'anterior' and 'posterior,' they are 'inferior' and 'superior' transverse processes. I have proposed the single-worded term 'parapophysis' for the 'inferior transverse process' or 'radix antica,' &c., and 'diapophysis' for the 'superior transverse process' or 'radix postica,' &c.

The transverse processes in fishes are, as John Müller and others have shown, 'parapophyses'; those of Mammalia, where they occur as a single pair, are 'diapophyses.' The Hyperoodon, however, shows a structure which leads to the conclusion that the transverse processes of the vertebræ with one pair of such are 'parapophyses,' as in fishes.

In the first to the sixth pairs of thoracic ribs the head of the rib articulates with the interspace of the vertebral bodies (centrums) and to contiguous parapophysial tubercles; the tubercle of the rib articulates with a diapophysis from the base of the neural arch: in the seventh dorsal vertebra a well-marked parapophysis is developed from the centrum, for articulation with the head of the rib, the tubercle still articulating with the diapophysis above. In the eighth dorsal vertebra the diapophysis abruptly ceases to be developed; the tubercle of the rib, which was reduced in the seventh pair, also disappears; and the eighth rib articulates, like the ninth, by the head only to a progressively elongating parapophysis: the long transverse pro-

cesses from the succeeding lumbar and caudal vertebræ are plainly continuations of the parapophysial series.

This repetition of a piscine structure, although an exceptional one in the fish-like mammalia, has appeared to me to be so interesting a fact, as to be worth recording. I am not aware, at least, that it has been previously noticed.

XLIII. — *Remarks on* Libellula Brodiei (*Buckman*), *a Fossil Insect from the Upper Lias of Dumbleton, Gloucestershire.* By Professor Buckman, F.G.S., F.L.S.

As our associate, the Rev. P. B. Brodie, is leaving this district, I have much pleasure in calling the attention of the Members of the Cotteswold Club to the interesting discoveries of fossil insects from the Lias, which he has principally made within the limits of our more immediate operations, namely in the county of Gloucester; and this I think right to do now with the more immediate object of settling a question of nomenclature, and in order that our 'Proceedings' may perpetuate his name as attached to one of the most beautiful and perfect specimens he has yet discovered, to whom the following remarks will show that it was originally dedicated. In order to render this the more clear, it will be necessary to state that while Mr. Brodie was prosecuting his inquiries in the *Lower Lias*, in a band of which, termed by him the 'Insect Limestone,' he succeeded in exhuming remains of almost every class of Insecta, I had the pleasure of finding among others a fine wing of *Libellula* in a thin band of limestone in the *Upper Lias*: this discovery was announced to the Geological Society in a short paper "On the occurrence of Remains of Insects in the Upper Lias of the county of Gloucester;" and in vol. iv. part 1. page 211 of the 'Proceedings' of the Geological Society will be found the following remarks:— "The remains of insects comprise one species of *Libellula*, which, from the reticulations of the fine wing, seems to belong to the genus *Æshna*, and has been named by Mr. Buckman *Æshna Brodiei* in honour of Mr. Brodie."

Between this (June 21, 1843) and the publication of the 2nd edition of the 'Outlines of the Geology of the neighbourhood of Cheltenham,' in 1845, I had the pleasure of discovering another fine wing, and this and the previous one were first figured in that work, tab. 8. figs. 1 & 2, with the following description:—

"Fig. 1. *Posterior* wing of *Æshna Brodiei*.
"Fig. 2. *Anterior* wing of ditto."

showing that I had arrived at the conclusion, that these two wings should both be referred to the same species.

However, later in the same year, Mr. Brodie published his highly valuable 'History of the Insects of the Secondary Rocks,' in which work (pl. 8. figs. 1 & 2) the same wings are beautifully figured by Mr. Westwood, with the following explanatory remarks:—

"Plate 8. fig. 1. A remarkably fine wing of *Libellula*.
"Plate 1. fig. 2. An equally fine wing of an *Agrion*."

These at p. 101–2 of the same work are named—

"Fig. 1. *Libellula Brodiei*.
"Fig. 2. *Agrion Buckmanni*."

So that here we see that not only were these specimens doubted as belonging to the same species, but are positively assigned to distinct genera.

However, in 1848, Mr. Brodie's labours were rewarded by finding a most perfect *Libellula* in the same bed, with the four wings attached to the nearly perfect body. This unique specimen will be found figured in the 'Quarterly Journal of the Geological Society,' vol. v. pl. 2, and an examination of the fossil shows that the anterior wing is identical with that referred to *Agrion Buckmanni*, and the posterior to that of *Libellula Brodiei*; and at page 35 of the 'Journal' for 1848 is the following statement:—"According to Mr. Westwood, the wing figured in my work on 'Fossil Insects,' p. 8. f. 2, is not an *Agrion* as there supposed, but belongs to the same species as the one above described" (*Æshna Brodiei*, Buckman); and further, "Mr. Westwood considers that it will be better to adopt *Libellula* as the generic title, while the peculiar veining of the wings will form the ground for a provisional subgeneric one, which he names *Heterophlebia*; hence I propose provisionally to name it *Libellula* (*Heterophlebia*) *dislocata*, Brodie*."

Now it is quite clear that according to proper custom the specific name should not have been altered, so that, as the two specimens cited were after all found to resolve themselves as I supposed into one specific form, however my generic name might have been changed—for which I can see but little reason—yet the specific one should have remained intact. This beautiful specimen therefore should be designated as *Libellula Brodiei* (Buckman), as it was originally dedicated to the author of 'Fossil Insects' when even a single wing was one of the best insect specimens that had been obtained, and he is not the less worthy of having his name preserved for the perfect example. These remarks are made not only with the hope of correcting

* Brodie in Journal of Geol. Soc. vol. v. p. 35.

what I have deemed an error, but they may be useful as showing us how cautious we should be in founding genera from fragments: this is a most prolific cause of synonyms, with which no science is so overloaded as geology.

Cirencester, Sept. 1853.

XLIV.—*On* Gallionella ferruginea (*Ehrenb.*). By J. W. Griffith, M.D., F.L.S.

In the water of bogs and pools, especially those containing much iron in solution, there are occasionally found microscopic organisms, myriads of which are aggregated around the living or dead stems of plants contained in the water, and forming around them reddish or yellowish brown flakes or filmy masses. The general appearance of these organisms has been well described by Ehrenberg in his great work on the Infusoria*, by whom they were placed in the genus *Gallionella*, with the specific name *ferruginea*. Mr. Ralfs places them among the Diatomaceæ, in the genus *Melosira*, with the specific name *ochracea* †. As the writings of these authors are in every one's hands, we shall pass them over. The latest writer, Kützing, gives the following generic and specific characters :—

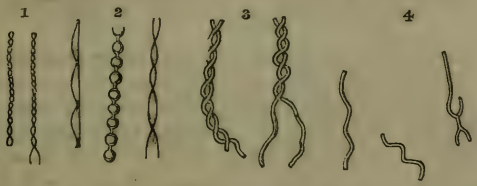
"*Glœotila*, Kützing.—Trichomata eramosa viridia mucosa, ex cellulis monogonimicis composita.—(Paludosæ, inundatæ.) *Gl. ferruginea*, Kg. Phyc. Germ. p. 191.—*G. ochracea*, trichomatibus brevissimis moniliformibus, articulis ovato-globosis. Diam. $\frac{1}{2000}'''$. —*Gallionella ferruginea*, Ehrenb. Infus. t. 10. f. 7.—*Melosira minutula*, Brébiss. Falais. p. 42. pl. 5.—In fontibus martialibus (v.v.). —Cf. Kg. Bacillar. p. 56, *Gallionella ferruginea*."

Neither of these observers has detected their true structure; nor is this to be wondered at, for the filaments are exceedingly minute (varying from the $\frac{1}{5000}$ to $\frac{1}{30,000}$ inch in breadth, but generally from $\frac{1}{10,000}$ to $\frac{1}{20,000}$), and it requires no ordinary management of the microscope to render it distinct. Each filament consists of two interlacing fibres, forming flattened compound spirals. The fibres are coloured by peroxide of iron; but they contain no silex, or at least not more than a mere trace, such as is naturally invariably associated with the peroxide. If the filaments be macerated for some time in distilled water, the fibres will separate; but they may be clearly distinguished in the compound filaments with the aid of a good object-glass of high power (400 to 500 diameters); in fact they form an admirable test-

* See Pritchard's History of Infusorial Animalcules, 1852.

† Ann. Nat. Hist. (1843) vol. xii. p. 351.

object for the general excellence of an object-glass; also of the observer's management of the microscope, for the correction must be accurately adjusted, and the filaments must lie flat upon the slide, otherwise the true structure cannot be made out. I shall detail some further particulars in regard to this beautiful and interesting object, in my forthcoming work "On the Microscope as a means of investigation."



1. *Didymohelix ferruginea*, magnified 220 diameters.
2. The filaments seen when lying sideways, or the adjustment and correction not perfect: 700 diameters.
3. The filaments lying flat (800 diameters), and the uncoiled fibres quite distinct.
4. The filaments separated by maceration.

This organism differs in structure from all others known, and cannot be retained in Kützing's genus *Glœotila*. We therefore propose the name *Didymohelix*, to designate the genus in which it must be placed.

9 St. John's Square.

BIBLIOGRAPHICAL NOTICES.

The Botany of the Eastern Borders, with the popular names and uses of the Plants, and of the customs and beliefs which have been associated with them. By G. Johnston, M.D. &c. 8vo. London, 1853.

We have allowed too long a time to pass since the publication of this very nice book without directing attention to it. Although it is called Vol. I. of a work entitled "The Natural History of the Eastern Borders," it is complete in itself as a Flora of that district, and is provided with a separate title-page accordingly. It will be remembered that some years since Dr. Johnston published an account of the plants of that part of England and Scotland, under the title of "A Flora of Berwick-upon-Tweed," and, as he has continued since that time to add to the amount of his knowledge of the native vegetation of his neighbourhood, the present Flora is the result of very long and extended research. But the book is far from being merely a catalogue of plants, for in addition to a full statement of the loca-

lities inhabited by the species, and the circumstances under which they inhabit them, the author has introduced innumerable notes concerning the topography, antiquities, history, scenic beauty, and folk-lore of many of the spots mentioned, and interesting biographical sketches of persons connected with the district. We know of no work at all approaching this, in the skill with which a dry botanical catalogue has been converted into a book of high interest even to the non-botanical reader.

The volume commences with a general account of the district, describing its limits, soil, water, climate, coast, mountains and hills, valleys and their rivers. Then follows the Flora, which is made the vehicle for conveying most of the information upon folk-lore, &c., to which we have referred. Then, an interesting tract on "Our Wild-flowers in their relation to our pastoral life" is introduced; and the book concludes with "The Fossil Flora of the Mountain Limestone formation of the Eastern Borders in connexion with the Natural History of Coal," by G. Tate, F.G.S.

There are twelve plates, bearing representations of botanical subjects chiefly, and we are sorry to have to add, that they are several of them far from being such as we could have desired. The representations of the *Hieracia* do not convey to us much idea of the plants intended. In some few cases also the language employed is scarcely so accurate as we expected from a learned and accomplished person. The tendency to the use of hard words is, however, far less manifest than it was in some of the author's former works. We must be allowed to repeat a wish that has been frequently expressed in these Annals, that writers upon Natural History would take care not only not to go out of their way to use the crabbed terms employed by some German scientific men, but would in all cases endeavour to convey their meaning in simple language whenever it can be done without detriment to science.

In looking over this Flora we have marked a few points which seem to deserve notice. The nomenclature is that employed by Sir J. E. Smith, but "when they differ, the names used in Mr. Babington's Manual and in the British Flora, as edited by Professor Arnott, are also given." We doubt that good judgement is shown therein; for, that that nomenclature is often erroneous appears to be proved by the concurrence of the authors of our two above-named modern Floras in its disuse in many cases. We do not blame Dr. Johnston for not adopting the changes made by either one of the writers of these books, but do think that when they concur, and especially when that concurrence is in accordance with the views of the best modern writers on the Flora of Europe, he should have made his nomenclature correspond with theirs.

Ranunculus aquatilis α. "*heterophyllus*, with none of the leaves hair-like." If so, why call it *heterophyllus*? For it is certainly not the plant so named by other botanists, in which the lower leaves are what Dr. Johnston calls "hair-like," and the upper ones flat. The truth is, that he has attempted to include many different plants under the one name of *R. aquatilis*, and has therefore rendered it im-

possible to learn from his book what are really the species that inhabit the border country.

Rubus. Under this heading some very interesting and valuable remarks upon the so-called species of that intricate genus are given. The following is the list of species found in the district:—

R. idæus,	R. carpinifolius,
R. plicatus,	R. leucostachys,
R. nitidus,	R. rudis,
R. corylifolius,	R. radula,
R. macrophyllus,	R. Kœhleri,
R. cordifolius,	R. cæsius.
R. mucronatus,	

These plants are more or less fully described, and the remarks upon them will doubtless greatly assist the student.

R. corylifolius is stated to be "apparently different" from that of Mr. Babington. We think that it accords with the *var. purpureus* of that botanist.

R. cordifolius. This is distinguished from *R. rhamnifolius*, but we have neither time nor space to enter into a discussion of the correctness of that opinion here.

Ribes rubrum. Dr. Johnston considers that the Gooseberry and Red Currant are indigenous in England, and refers to the late Dr. Bromfield's elaborate remarks on the subject (Phytol. iii. 377) as conclusively supporting their claims. Our author thinks that many plants which are looked upon as doubtful natives, owing to their very local distribution, or their presence now solely in hedgerows or thickets, are aboriginal inhabitants of our country, having once been much more plentiful, but become confined to the few wild spots or artificial localities which they now inhabit by the destruction of the primæval woods. We agree with him in believing that we may carry our scepticism much too far in this matter; and that many of our hedge-plants which have recently been stigmatized as "aliens" are more truly native than several of those which are universally recognized as such. However wise it may be to be cautious in admitting the indigenous character of newly-observed plants or of those inhabiting arable land—and wise it certainly is—we should be especially cautious not to allow our doubts to carry us too far. We would direct attention to Dr. Johnston's remarks on this subject (pages 53, 84, 139).

Hieracium. A rather full account is given of the species belonging to this ill-understood genus which occur in the district. It does not seem to us to be of nearly so much value as the remarks upon the *Rubi*, but will require to be carefully studied by those who are endeavouring to determine the value of the numerous forms presented to our notice by the British Hawkweeds.

At the end of the list of Compositæ we are favoured with a very curious discussion of the question, "What is the Scotch Thistle?" The answer given by Dr. Johnston is that "the evidence seems greatly to strengthen our belief that *Carduus Marianus* was the chosen emblem of the national pride and character."

In conclusion, we beg leave most cordially to recommend this book to all of our readers, assuring them that, even if very slightly, or not at all acquainted with botany, they will find much to amuse, interest and instruct them.

The Handbook of British Ferns, comprising scientific and popular Descriptions with Engravings of all the Indigenous Species and Varieties, with Instructions for their Cultivation. By T. Moore, F.L.S. &c. Second edition. London, 1853.

This new edition of Mr. Moore's nice little Handbook is one-half larger than its predecessor, and in many other respects much improved. The introductory remarks upon the structure of Ferns have been very much extended, and a clear statement of the views of Suminski and others on the obscure subject of their reproduction is included amongst them. Then follows an account of the geographical distribution of our native species; directions for their culture; and their classification. In the latter no material change is made from the mode of arrangement that is now most generally adopted, but an account is given of the recent schemes of Mr. J. Smith of Kew, and Mr. Newman, and reasons pointed out which militate against their acceptance. In not adopting the views of those distinguished students of, and writers concerning, Ferns, we think that Mr. Moore has done wisely. It seems to us that the new arrangement derived from the mode in which the fronds are developed from the caudex, and their articulation to it, would lead to the separation of groups far more natural than those which it would form.

With the chapter headed Classification the introductory part of this book may be said to conclude; the remainder of it being occupied by a detailed account of the several genera and species; this part of the work is a very great improvement upon the corresponding part of the former edition.

The *Polypodium alpestre* is placed in that genus, as we think correctly, and we concur with the author in not being as yet convinced that the *Pseudathyrium flexile* of Newman is distinct from it. We believe that our friend Mr. Backhouse does consider that they are different species, and as he has had the opportunity of studying the two plants in their native wilds, and his opinion would otherwise have had considerable weight with us, we think it right to suspend our judgement on the matter, which will doubtless be fully discussed in Mr. Newman's long-delayed new edition of the History of British Ferns.

A very nice figure of the *Gymnogramma leptophylla* is added to this edition. We may hope that now that it has been determined to be certainly a native of Jersey, it will soon be detected in Cornwall or the warm southern part of Devonshire. The botanists of those districts will do well to search carefully for it in spring upon moist banks having a southern aspect.

Mr. Moore has joined the *Lastrea spinulosa* to the *L. cristata*, considering that Mr. Newman's *L. uliginosa* connects them. Doubtless there is much difficulty in determining the true place of *L.*

uliginosa, the fertile fronds of which do certainly very closely resemble those of *L. spinulosa*, but we do not think that there is, at present, sufficient evidence to show that it is really a connecting link between the latter plant and *L. cristata*.

From the plants that have been usually combined under the name of *Athyrium filix-fœmina*, the variety *convexum* of Newman is separated, and stands as a species under the name of *A. rhæticum*, Roth. We are inclined to admit this "split," on account of the constant dissimilarity of the plants. The *A. rhæticum* can hardly be confounded with any of the forms of the variable *A. filix-fœmina*. We are not satisfied that the correct name has been adopted for it, because there remain some doubts as to what plant was intended by Linnæus under the name of *Polypodium rhæticum*.

With these remarks we conclude, only adding that we can cordially recommend Mr. Moore's book.

Beiträge zur Mycologie. Von G. Fresenius, M.D. Frankfurt A. M. 1850, 1852. Hefte 1, 2. 4to, pp. 38. pl. 4, & pp. 80. pl. 5.

It has been objected against the German botanists of the present day, and not without good reason, that they work too frequently in almost utter ignorance of what is done by French and English botanists as regards the very subjects on which they are occupied. If this applies with any degree of justice to those who are engaged in the study of Phænogamous plants, much more so is the charge applicable to their Cryptogamists. Species which are in the hands of every one, and which have been long since described, are daily brought forward as new, and this frequently even where German authors have already published their observations. One lichenologist, for instance, coolly states his ignorance of the works of Hedwig and Dillenius, while others professedly have never consulted the large collections of Corda, and even in publications like Sturm's Deutschlands Flora, a work which bears a high character for general correctness, many species appear under new names which have long since been published, while representations of things entirely different are given for common species, such as *Peziza aurantia*.

Meanwhile it is most unfortunate as regards Mycology, that the copious collection of Rabenhorst, though containing many subjects of first-rate interest, is so little to be trusted in respect of nomenclature. Some very gross errors have been pointed out by the editor himself, who seems to depend very greatly upon others, not only for specimens, but for names, and we could ourselves furnish a list of some length. We believe that Klotzsch has had little or nothing to do with the work, since the completion of the second number.

If however a very glaring instance is wanted in confirmation of our remarks, we need but refer our readers to the work of Bonorden on Mycology, which, though containing some good figures amidst a good deal of trash, is full from one end to the other of the grossest blunders, not only as regards synonyms and nomenclature, but even in points of affinity, where the merest tyro might have come to a true judgement. It is therefore with some pleasure that we are able to

refer to the work whose title is placed at the head of this notice, as containing matter of a sterling character, and which gives promise of much that is sound and genuine. With all his faults, Corda has done a great deal for Mycology, and we should gladly see some one treading in the same footsteps as regards copiousness of illustration, for which a land singularly fertile in mycological productions is most favourable, but avoiding his looseness of synonyms and perplexity as regards everything like system and affinity. There was perhaps some little room for dissatisfaction in the first fasciculus of our author, but if there were just ground for this, we can speak with almost unmixed praise of the second part, which leaves but little to desire, either in point of illustration, or correct appreciation of the requisites of such a publication. As regards the illustrations, we can speak most favourably of their truth and correctness, while every possible pains have been taken to identify the new species with those which have been already published, both in this country and on the continent. We have noticed but one clear case of *double emploi* in the second fasciculus, viz. that of *Myxocyclus confluens*, Riess, which is certainly identical with *Hendersonia polycystis*, Berk. & Br., in Annals of Nat. Hist. vol. v. p. 374, where the gelatinous envelope is even more perfectly described than by Fresenius. That this envelope is not of generic importance is proved by numberless instances in the sporidia of *Sphæria* and other genera. We would observe also, that it is impossible to establish genera in *Sphæriaceæ* simply by the structure of the sporidia, otherwise species of undoubtedly close affinity will be very widely separated. We suspect that a comparison of specimens would be destructive to one or two more supposed new species, but without absolute inspection we are unwilling to throw out doubts which might prove groundless.

In the first fasciculus, if we mistake not, *Arthrobotrys oligospora* is nothing more than *Trichothecium roseum* correctly observed, *Septosporium nitens* is clearly *Macrosporium sarcinula*, Berk. Ann. of Nat. Hist. i. p. 261, and *Nemaspora persicina* is *Cytispora orbicularis*, l. c. p. 207, which more properly belongs to the genus *Glœosporium*.

Mistakes however are inevitable in so difficult a subject, even with the best materials and with access to the most perfect libraries, and there is so much really valuable in the work of Dr. Fresenius that it can well afford to have a few errors pointed out.

A Monograph of the Subclass Cirripedia, *with figures of all the species. The* Lepadidæ *or Pedunculated Cirripedes.* By Charles Darwin, F.R.S., F.G.S.*

It is not without some shame that we confess, that we, who ought to be the heralds and indicators of all good work done in Natural History, should have allowed ourselves to be anticipated in justly appreciating the very high merits of Mr. Darwin's Monograph by a body, which we may venture to say, with all respect, is not usually complained of for the too great rapidity of its operations—the Royal

* Ray Society, 1851 (published end of 1852).

Society. Exercising what we cannot but think a most wise discretion, the Council of that learned body has conferred upon Mr. Darwin one of the Royal Medals for the present year: and in paying due honour to abilities so various and so solid as those which have enabled their possessor to produce the most charming book of scientific travels since Humboldt's personal narrative, and who now, turning from the beauties of the great works of nature, has employed the same patient, conscientious labour, in the same comprehensive and philosophical spirit with equal success, upon some of the least attractive and most difficult of her more obscure, though to a right vision, not less wonderful or beautiful creations, they may, we venture to say, claim their own share of honour from the public.

Nor, while we are expressing approbation, should the Ray Society go without its meed. The British public in matters scientific is not unlike the Indians of the Orinooko, who care not much whether they dine on dirt or deer; the great point, say they, is to fill the stomach. So we have heard grumblings from the members of the 'Ray' that they do not get books enough or often enough. We would advise them to utter no more such murmurs, or worse things may befall them. In nine years their Council has published *the three best Monographs in Europe* in their respective departments, viz. that of Prof. Forbes on the Naked-eyed Medusæ, that of Messrs. Alder and Hancock on the Nudibranchiate Mollusca, and that under notice on the Cirripedia. A fourth most excellent original work has been furnished by Dr. Baird, and a very good, though in the matter of plates very defective, treatise by Mr. Leighton. Of the multitudinous reports and translations we need say nothing.

We may now proceed to indicate the principal points of novel interest in the pages of Mr. Darwin's admirable work.

In the first place he furnishes us with what is essential to all exact study of a class of animals, a definite and scientific nomenclature of the parts of all its members. Passing from this to the Lepadidæ, which are the special subject of the present volume, we find a careful section devoted to their development. Here, the errors of the early observers, who imagined that the larvæ of the Lepadidæ and Balanidæ differed, are explained by showing, what Burmeister first discovered, that all these larvæ pass through two states, the earlier having a flat carapace prolonged into lateral horns, the later possessing a cypriform bivalve carapace. Between these two states there is a transition condition. In the first state the mouth appears to be open, in the last it is closed, so that the creature now justly deserves the title which Mr. Darwin has given it of 'locomotive pupa.'

The locomotive pupa, besides the long antennæ and the eyes, already known, has what Mr. Darwin considers to be auditory organs placed at the anterior end of the sternal surface of the carapace. Within the antennæ Mr. Darwin has discovered ducts terminating close to the suctorial discs, and proceeding from two glands in the neighbourhood of the stomach. These play a most important part in the future proceedings of the animal, and give origin to what the author terms the cement-glands and ducts. When the final meta-

morphosis of the larva takes place, a sort of process is developed from the thorax (well compared by Mr. Darwin with that which supports the antennæ and eyes in *Lucifer*) bearing the antennæ and eyes upon its extremity, and not, as had been supposed, constituted by the union of the former. It is this process which becomes the peduncle of the future Lepas in the following manner. The larva fixes itself by the suckers of its antennæ, and then pours out from its cement-ducts a quantity of chitinous cement, by which it becomes glued to the surface of attachment. The compound eyes are exuviated (to be replaced by a single deep-seated eye in the adult), but the antennæ remain, and may always be discovered even when the animal has attained its full development. At the same time a still more important and remarkable change goes on in the remainder of that glandular organ to which we have referred as giving rise to the cement-gland. It sends out ramified processes, part of which remain in the body of the animal and part occupy the peduncle, in which ova are developed; so that, from what was apparently one gland we have two formed, the cement-gland, whose duct opens externally in the antennæ, and the ovary, which never developes a duct at all. Well may the author say, that this is "perhaps the most curious point in the natural history of the Cirripedia." We do not think, however, that it is quite so anomalous or without analogy in other divisions of the animal kingdom as Mr. Darwin appears inclined to suppose; for, putting aside the egg-pouches of *Cyclops* and the well-known glands which secrete an adhesive substance in the female Epizoa, and which are diverticula of the common genital tract, we may refer to the genitalia and Wolffian bodies of mammals as presenting very similar relations.

It is worth remark also, that in *Argulus*, Leydig (Siebold and Kölliker's Zeitschrift, 1852) describes a cephalothoracic spine with glands and ducts occupying a position not altogether dissimilar to the cement-gland.

The respective import of the organs now recognised as generative has been the subject of a great diversity of opinion, expressed by Hunter, Cuvier, Burmeister, Wagner, St. Ange, Mayer, Steenstrup, Goodsir, Leuckart, and Siebold. The truth appears first to have been made out by Wagner and St. Ange, and the exact structure of the testes with their ducts, and of the ovaries, was carefully described by Leuckart (Zur Morphologie und Anatomie der Geschlechtsorgane, 1847), whose account fully agrees in essentials with that of Mr. Darwin. Like him he was unable to discover any external oviducal aperture. On the other hand, Wagner and Siebold (Vergleich. Anat. p. 485) describe as an oviduct a canal extending "from the lower extremity of the valve of the shell downwards on the corresponding side of the foot (peduncle), and opening above by a narrow cleft into the mantle cavity," which is also described by St. Ange.

Mr. Darwin has carefully sought for, but cannot find, this aperture, and we may therefore conclude that it does not exist. He believes, on the other hand, that the ova are detached within the body, enter the vascular sinuses, and by them are carried to the inner sur-

face of the sac or mantle. Here each becomes invested by a sheath formed by the chitinous epidermis of the sac. A new epiderm being developed on the inner, or under, surface of the sheet of ova, they are detached, adhering only by a small band,—the 'ovigerous frænum.' As there is no vagina, Mr. Darwin supposes that the ova are fecundated as they pass out, but seems inclined to think that an internal communication between the two sets of organs may also exist. Such a mode of exit appears at first sight anomalous enough, but is not without sufficient analogy. In the *Salpæ*, for instance, the ova, which lie almost free in the blood-sinuses, only attached by a delicate pedicle, are extruded without any oviduct by passing into a diverticulum of the wall of the sinus which gradually closes behind them; and there are Annelids in which exactly the same process takes place.

We should far exceed our limits if we were to advert to all the matters of interest in this remarkable book. Those who wish to learn many anatomical novelties—the nature of the nervous system, of the olfactory and auditory organs, &c., must turn to the work itself. We can here only advert to two points, which, like children, we have reserved as *bonnes bouches* for the end.

In the first place, we could not have held up our head again in the critical chair without finding an error; and here it is: "Chitine is confined to the Articulata;" though, as it is only contained in a note at p. 30, and is by no means of importance to the general purport of the work, the difficulties of our search may be conceived. Seriously, however, we notice the mistake because it is one which is very generally admitted. The fact is, on the contrary, that Chitine exists in the jaws and sepiostaire of Cephalopods; in the lingual plate in these and the Gasteropoda—the jaws of *Helix*—the shells of *Cymbulia*, *Aplysia* and *Bullæa*—the byssus of Lamellibranchs—the shell of *Lingula* and the skeleton of *Gorgonia*,—besides being present in a number of the annuloid forms of the Radiata (Leuckart, Wiegm. Arch. 1852).

The other matter to which we would refer is Mr. Darwin's discovery—most important in a physiological point of view—of the existence, in certain species of *Ibla* and *Scalpellum*—true and complete hermaphrodites, be it remembered—of what he aptly terms '*Complemental Males*.'

Mr. Darwin appears to us to produce an overwhelming body of evidence in favour of the conclusions at which he arrives, which are, in a few words, these:—In certain species of these two genera the generality of the larvæ become Barnacles, to all appearance as completely provided with all the requisites for the continuation of the species as the other members of the genus, the testes and ovaria being well-developed. A careful eye, however, might discover pits on the scutum or folds upon its edge, of a peculiar character. The fact is, these pits and folds are a sort of arm-chairs for the occupation of a small male, developed from certain other ova, who at an early period of development takes possession of his seat, and attains no further stage. Mouthless and stomachless, 'wholly supported by

his family,' his sole function appears to be, to develope and excrete his spermatozoa, and then die out of the way to make room for a successor in the marital rostrum.

In all physiology we know of no case parallel with this; and the only light upon it at present appears to us to be afforded by the discovery, also due to Mr. Darwin, that in other species of these genera a complete separation of the sexes is to be met with. Are some of the transitional species between the monœcious and diœcious forms a sort of hermaphrodite 'free-martins' in the male division, requiring extraneous assistance?

But we must conclude, and those of our readers who understand that scientific zoology is a different matter from more or less effectually tanning and naming animal exuviæ, will, we are sure, join us in offering to Mr. Darwin—what even a Royal medal attains its only true value by expressing symbolically—the hearty thanks of all his fellow-workers.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

July 22, 1851.—John Edward Gray, Esq., F.R.S. &c., Vice-President, in the Chair.

On some genera of Shells, established in 1807 by the late H. F. Link. By Dr. Herrmannsen, of Kiel.

In several programs, hitherto not at all taken notice of by any Conchologist, the renowned Botanist Link of Berlin, then Professor of Natural History, Chemistry and Botany at Rostock, in the course of the years 1806 to 1808, has published an account of the Collections of the Rostock University. These little treatises seem to be very rare, nor do I remember ever to have found them mentioned, before my 'Index Generum Malacozoorum' recorded them. Yet they may claim priority in many instances, which I hope will be redeemed by simply noticing their contents. The German titles of these octavo pamphlets are as follows:—

Beschreibung der Naturalien-Sammlung der Universität zu Rostock, von Dr. H. F. Link. Rostock. Gedruckt bei Adlers Erben.
Erste Abtheilung; zum Weihnachtsfest, d. 25 Dec. 1806 (p. 1–48).
Zweite Abth.; zum Osterfest, d. 29 Marz 1807 (p. 49–98).
Dritte Abth.; zum Pfingstfest, d. 17 Mai 1807 (p. 99–165).
Vierte Abth.; zum Weihnachtsfest, d. 25 Dec. 1807 (p. 1–30).
Fünfte Abth.; zum Osterfest, d. 7 April 1808 (p. 1–38).
Sechste Abth.; zum Pfingstfest, d. 5 Juni 1808 (p. 1–38).

Passing over those genera which are either superfluous because formerly rightly published under other names, or unhappily contrived, I will hint at those that may deserve to be attended to.

Mollusca. Gasteropoda. Siphonobranchea.

Lambidium, Link, 1807, *l. c.* iii. p. 112.

Spire little prominent; aperture longitudinal, narrow; inner lip callous, with raised points; outer lip marginated; base truncated; shell destitute of varices or spines.

Lambidium oniscus (*Strombus*), Linn.

This genus having been indicated in 1798, by Dr. Bolten, as *Morum*, but without definition, the botanical signification of that name may have induced Link to select another, which, being correctly founded, must be preferred to *Oniscia* of Mr. Sowerby; or at least, if we should dissect the genus with Dr. Gray, into *Oniscia*, *Sconsia*, and *Morum*, to the last.

Phalium, Link, 1807, *l. c.* iii. p. 112.

Spire shorter than the last whorl; aperture longitudinal, wide; inner lip callous and smooth, or extended into a folded or granulated lamina; outer lip marginated; shell often varicose; base strongly recurved, notched; inner columella not folded.

A. Lamina of the inner lip folded: *Phalium glaucum* (*Buccinum*), Linn. &c.—B. Lamina of the inner lip granulated: *Phalium erinaceum* (*Bucc.*), Linn. &c.

This is *Bezoardica*, Schum., or *Cassidea*, Swains.

Cassidea, Link, 1807, *l. c.* iii. p. 111.

Spire little prominent; aperture longitudinal, narrow; outer lip marginated, like the inner one, with many folds; shell spineless, often varicose; base strongly reflected, notched; inner columella folded.

Cassidea rufa, tuberosa, cornuta, testiculus, flammea, pennata.

This has been proposed by Mr. Stutchbury as *Cypræcassis*, but must at all events retain the name of *Cassis*, Browne, 1756.

Galeodea, Link, 1807, *l. c.* iii. p. 113.

Spire much shorter than the last tumid whorl; inner lip extended in shape of a smooth lamina; outer one slightly marginated; base rather elongated, reflected, not emarginate.

Galeodea echinophora (*Bucc.*), Linn.

Synonyms are *Morio*, Montf., and *Cassidaria*, Lamck., both of a more recent date.

Thais, Link, 1807, *l. c.* iii. p. 114.

[*Thais* of Bolten Mus. includes some *Ricinulæ* and *Monoceros* of Lamarck, from which Link has depurated it.]

Spire shorter than the last, ventricose whorl; aperture semicircular; inner lip plane, obliquely cut off, callous, smooth; outer lip scarcely marginated; shell without varices; base short.

Thais Persica (*Bucc.*), Linn.—*patula*, Linn. sp.—*hæmastoma* (Chemn. fig. 964, 965).—*fucus*, Gmel. sp.—*minuta*, Link.

This genus, which is synonymous with *Microtoma*, Swainson, I should think advisable to be retained at least as a section of the hitherto confused genus *Purpura*.

Mancinella, Link, 1807, *l. c.* iii. p. 115.

Spire much shorter than the last whorl; aperture longitudinal, rounded: inner lip smooth and callous, outer one little or not at all marginated: shell without varices, but provided with spines and imbricate scales; base short, or scarcely elongated, twisted outwards, slightly notched.

Mancinella armigata (Chemn. 967, 968).—*hystrix*, Linn. sp.—*castanea*, Link (Chemn. 956–958).—*armigera*, Chemn. sp.—*mutabilis*, Chemn. 951–953.—*Bezoar*, Chemn. 754, 755.

This genus, combining some *Purpuræ* with some *Pyruli* of Lamarck, comes near to *Rapana a*, Schum., and perhaps may be adopted.

Volema, Link, 1807, *l. c.* iii. p. 115. (*Volema*, Bolt. emend.)

Spire much shorter than the last whorl, often distorted; aperture oblong, rounded; inner lip smooth and callous, outer lip simple; shell without varices; if grown old, with spines or imbricated scales; base elongated, rather turned aside.

The species are to be found in my 'Ind. Gen. Malacoz.' vol. ii. p. 699.

This genus unites *Busycum*, Bolt. (=*Fulgur*, Montf.) with *Cassidulus*, Humphr., Gray.

Xancus, Bolten, 1798, Mus. (edit. 1819, p. 94); Link, 1807, *l. c.* iii. p. 116.

Spire shorter than the last whorl; aperture above rounded, wide, below narrow; inner lip callous, with three folds; outer lip simple; shell heavy, without varices or spines; base elongated.

Xancus pyrum, Linn. sp., and *maculatus*, Link (Chemn. f. 917, 918).

This genus, by Humphrey called *Rapana*, by Fabricius *Pyrum*, by Dr. Gray *Turbinellus*, and by M. Deshayes *Scolymus*, is here characterized for the first time, and sufficiently.

Cymatium, Link, 1807, *l. c.* iii. p. 119.

Spire rather long; aperture above rounded; inner lip callous, with three folds; outer one marginated; a great number of crowded and ridged varices run down the shell, to which they are firmly grown: base little elongated.

Cymatium polygonum, &c.

This is quite identical with *Latirus*, Montf., or *Polygona*, Schum.

Vasum, Link, 1807, *l. c.* iii. p. 119. (*Vasum*, Bolt. emend.)

Spire rather long; aperture longitudinal; inner lip callous, with alternately larger folds; outer lip simple; shell without distinct varices; base elongated.

Vasum Ceramicum, Linn. sp., &c.

This is *Cynodonta*, Schum., *Scolymus*, Sw.

Tudicla, Link, 1807, *l. c.* iii. p. 120. (*Tudicla*, Bolt. emend.)

Spire very short, depressed; aperture above semicircular; inner lip callous, with a single fold; outer one simple; no varices or spines; canal straight, thin.

Tudicla spirillus, Linn. sp.

Subsequently established as *Haustellum a*, Schum., *Pyrella*, Swains., *Spirillus*, Schlut., *Spirilla*, Sow. jun.

Tritonium, Link, 1807, *l. c.* iii. p. 121.

Spire rather long; aperture above rounded; inner lip callous, generally with small folds; outer lip marginated; shell with varices that are commonly discontinuous; base rather elongated.

With respect to this genus I may refer to my 'Ind. Gen. Malacoz.' vol. ii. p. 609.

Distortrix, Link, 1807, *l. c.* iii. p. 122.

Spire rather long; whorls distorted; inner lip callous, folded; outer lip marginated; varices indistinct; base short-tailed.

Distortrix anus, Linn. sp., and *reticulata* (Chemn. f. 405, 406).

This name then is to be substituted in the place of *Persona*, Montf.

Gyrineum, Link, 1807, *l. c.* iii. p. 123.

Spire nearly equal to the last whorl; aperture rounded; inner lip callous, often slightly folded or granulated; outer lip marginated; shell compressed, with two opposite varices; base short or a little elongated.

Gyrineum echinatum (Chemn. f. 1274, 1275), *rana* (f. 1269, 1270), *bufonium* (f. 1240, 1241), *natator* (f. 1229, 1230), *verrucosum* (f. 1233, 1234), *caudatum* (f. 1045–1047), *scrobiculator*, = *Ranella*, Lamck.

Canrena, Link, 1807, *l. c.* iii. p. 126.

Spire short; aperture longitudinal; inner lip folded; outer lip interiorly strongly dentated; shell crowded with spines, but without distinct varices; base short.

Canrena neritoidea (Mart. f. 972, 973, 976–979) = *Ricinula*, Lamck. &c.

Adelobranchea.

Astralium, Link, 1807, *l. c.* iii. p. 135.

Spire depressed; aperture broad, rounded, bending downwards.

Astralium deplanatum (Chemn. f. 1718–1720).—*Astralium calcar*, Gm., sp.

This genus will no doubt be acknowledged, being congruous with *Calcar*, Montf., Phil. It had been indicated before by G. Humphrey, under the name of *Sol*, and by Bolten as *Astræa*. But I think it should be extended farther, so as to receive *Imperator* and *Hercoles*, Montf., *Stellaria*, Schmidt, *Cyclocantha*, *Canthorbis*, subg., and *Tubicanthus*, Swains., *Bolma*, Risso, *Cookia*, Less., and *Astralium*, Phil.

Umbonium, Link, 1807, *l. c.* iii. p. 136.

Spire much depressed; aperture directed downwards, or to the side, simple; base showing a convex callus in the place of the umbilicus.

Umbonium vestiarium, Linn. sp., and *excisum* (Chemn. f. 1602).

That Link's name is to be adopted instead of *Globulus*, Schum.,

or *Rotella*, Lamck., can hardly be controverted; although his second species belongs to another tribe.

Pythia, Bolten, 1798, Mus. (ed. 1819, p. 74); Link, 1807, *l. c.* iii. p. 139.

Whorls, each of them composed of two pieces; aperture longitudinal, toothed on both sides.

Pythia scarabæa, Linn. sp.

This name is preferable to that of Fischer, *Polydonta*, which, although contemporary, is badly made, and wants correction.

Acephala.

Sunetta, Link, 1807, *l. c.* iii. p. 148.

Equivalve, in front rather obtuse, closed; hinge with two cardinal teeth, lateral ones indistinct; anterior slope shorter than the furrow-shaped posterior slope; ligament external.

Sunetta scripta (Chemn. f. 261–265) = *Cuneus*, Muhlf. 1811 = *Meroë*, Schum. 1817.

Tivela, Link, 1807, *l. c.* iii. p. 152.

Equivalve, longitudinal, without epiderm, closed; hinge with two cardinal and one elongated lateral tooth; anterior and posterior slopes equally elongated; ligament external.

Tivela vulgaris (Chemn. f. 362).—*T. tripla* (*Venus*), Linn. = *Trigona*, Muhlf. 1811.

Musculium, Link, 1807, *l. c.* iii. p. 152.

Equivalve, closed; hinge with two small cardinal teeth, no lateral ones; anterior and posterior slope nearly equal.

Musculium lacustre (*Tellina*), Linn.

The genus established here, fourteen years afterwards was published as *Pisidium*.

Tentaculata. See 'Ind. Gen. Malacoz.' ii. 541.

Verpa, Bolten, 1798, Mus. (ed. 1819, p. 49); Link, 1807, *l. c.* iii. p. 159.

Shell tubular, partly straight, partly winding, at one extremity open, at the other closed by a convex perforated blade.

Verpa penis (*Serpula*), Linn.

The oldest denomination of this genus that can be admitted; *Penicillus* (Da Costa, p.p.), Brug., being a term since the times of Rondelet consecrated to the Annulate class: all the other names, *Aquaria*, *Arytæna*, *Clepsydra*, *Aspergillum*, are of younger date, and will give way to *Verpa*, Bolt., defined by Link.

Descriptions of Forty-three New Species of Cyclostomacea, from the Collection of Hugh Cuming, Esq. By Dr. L. Pfeiffer.

1. Cyclostoma Himalayanum, Pfr. *C. testâ umbilicatâ, globoso-turbinatâ, solidulâ, costis spiralibus obtusis*, 10–12, *lineisque*

interjacentibus obsoletis sculptâ, sub epidermide deciduâ, ... albidâ; spirâ turbinatâ, supernè rufâ, acutiusculâ; anfractibus 5, *convexiusculis, ultimo ventroso, circa umbilicum angustum, infundibuliformem vix compresso; aperturâ subverticali, circulari; peristomate simplice, continuo, breviter adnato, fusco-igneo, subincrassato, breviter expanso, supernè subangulato.—Operculum?*

Diam. maj. 48, min. 39, alt. 35 mill.

Hab. in Himalayâ.

2. Cyclostoma euchilum, Pfr. *C. testâ umbilicatâ, turbinato-subglobosâ, solidulâ, obliquè confertim striatâ, lineis impressis distantioribus obsoletè clathratulâ, albidâ, violaceo-fusco et fulvo variegatâ, parum nitidâ; spirâ turbinato-elevatâ, apice acutiusculâ; anfractibus* $5\frac{1}{2}$, *convexis, ultimo rotundato, ad suturam subdepresso, medio albo-fasciato, basi confertim et valide spiraliter sulcato; umbilico mediocri, infundibuliformi; aperturâ vix obliquâ, subangulato-circulari, intus purpurascenti-carneo-micante; peristomate subcontinuo, albo, marginibus supernè dilatatis, callo subemarginato junctis, dextro et basali latissimis, fornicatim revolutis, sinistro angustato, vix reflexo.—Operculum?*

Diam. maj. 43, min. 32, alt. 28 mill.

Hab. Madagascar.

3. Cyclostoma crassum, Pfr. *C. testâ umbilicatâ, turbinato-globosâ, crassâ, striatâ et minutè malleatâ, rubello-fulvâ, fasciis et lineis interruptis castaneis ornatâ; spirâ turbinatâ, obtusiusculâ; anfractibus* 5, *convexis, ultimo supernè turgido, infra medium carinâ funiformi et fasciâ latiore nigricante circumdato, basi subplanulato, circa umbilicum angustum, infundibuliformem subcompresso; aperturâ obliquâ, subangulato-rotundâ, intus rubellâ; peristomate duplice: interno continuo, externo crasso, expanso, ad anfractum penultimum breviter interrupto.—Operculum?*

Diam. maj. 27, min. 23, alt. 18 mill.

Hab. Liew Kiew, et var. minor in insulâ Ibyat (Bashee group).

4. Cyclostoma expansum, Pfr. *C. testâ umbilicatâ, turbinato-subglobosâ, solidiusculâ, spiraliter confertim striatâ, opacâ, supernè castaneo et albido variegatâ; spirâ conoideâ, apice acutiusculâ; anfractibus* 5, *convexiusculis, ultimo convexiore, dilatato, peripheriâ subcarinato, basi fasciis angustis castaneis ornatâ; umbilico angusto, pervio; aperturâ subverticali, ferè circulari; peristomate subsimplice, continuo, breviter adnato, pallidè aurantiaco, undique æqualiter angulatim plano-expanso, margine subrevoluto.—Operculum?*

Diam. maj. 30, min. 22, alt. 19 mill.

Hab. ——?

5. Cyclostoma unicolor, Pfr. *C. testâ umbilicatâ, globoso-conicâ, solidâ, longitudinaliter confertissime et regulariter striatâ, spiraliter confertim sulcatâ, opacâ, fulvido-stramineâ; spirâ conicâ, subtruncatâ; anfractibus* 6, *convexiusculis, ultimo supernè et medio acutè carinato: carinâ tertiâ, validissimâ, circa umbilicum angus-*

tum, infundibuliformem, intus profundè spiraliter sulcatum; aperturâ parum obliquâ, angulato-circulari; peristomate simplice, marginibus callo lunatim exciso junctis, dextro expansiusculo, sinistro medio dilatato, patente.—Operculum?
Diam. maj. 20, min. 17, alt. 16 mill.
β. Majus, striis longitudinalibus obsoletioribus, albidum.
Diam. maj. 28, min. 22, alt. 20 mill.
Hab. ——?

6. Cyclostoma ponderosum, Pfr. *C. testâ latè umbilicatâ, conoideo-depressâ, crassâ, ponderosâ, subtiliter et obliquè malleato-rugulosâ, olivaceo-fusculâ; spirâ breviter conoideâ, obtusâ; anfractibus* 5, *parum convexis, celeriter accrescentibus, ultimo lato, subdepresso, ad peripheriam obtusè funiculato-carinato; aperturâ obliquâ, angulato-ovali, intus albâ, nitidâ; peristomate crasso, recto, subcontinuo, supernè angulato-dilatato, margine columellari perarcuato.—Operculum membranaceum, pellucidum, fusculum, arctispirum.*
Diam. maj. 36, min. 30, alt. 20 mill.
Hab. Guatemala.

7. Cyclostoma Dysoni, Pfr. *C. testâ umbilicatâ, conoideo-orbiculatâ, solidâ, pliculis confertis undulatis, subconfluentibus sculptâ, fusco-olivaceâ, pallidius strigatâ et obsoletè fasciatâ; spirâ conoideâ, obtusulâ; anfractibus* $4\frac{1}{2}$, *convexiusculis, celeriter accrescentibus, ultimo rotundato; umbilico mediocri, conico; aperturâ ferè verticali, angulato-subcirculari, intus cærulescente, nitidâ; peristomate simplice, recto, supernè angulato, breviter adnato, margine dextro declivi, columellari subdilatato-patente.—Operculum?*
Diam. maj. 27, min. 22, alt. 16 mill.
Hab. Honduras (Mr. Dyson).

8. Cyclostoma disculus, Pfr. *C. testâ umbilicatâ, depressâ, discoideâ, solidiusculâ, nitidâ, alabastrinâ; spirâ planissimâ; anfractibus vix* 4, *convexiusculis, ad suturam impressam striatis, ultimo teretiusculo, subdepresso, in umbilico lato distinctius striato, anticè brevissimè soluto; aperturâ subverticali, circulari; peristomate continuo, simplice, recto.—Operculum?*
Diam. maj. 14, min. 11, alt. 5 mill.
Hab. ——?

9. Cyclostoma desciscens, Pfr. *C. testâ latè umbilicatâ, depresso-semiglobosâ, supernè confertim sulculatâ, albidâ; spirâ convexâ; anfractibus* $4\frac{1}{2}$, *convexiusculis, ultimo terete, anticè subito deflexo, basi lævigato; aperturâ ferè horizontali, lunato-rotundatâ, intus albâ; peristomate incrassato, marginibus remotis, callo junctis, basali reflexo, columellari subito arcuatim ascendente.—Operculum?*
Diam. maj. 10, min. $8\frac{1}{2}$, alt. $5\frac{1}{2}$ mill.
Hab. Socotra.

10. Cyclostoma margarita, Pfr. *C. testâ perforatâ, globoso-conicâ, solidulâ, lævigatâ, nitidulâ, rubello-succineâ; spirâ conicâ, apice acutiusculâ, sanguineâ; anfractibus* 5, *convexiusculis, ultimo subrotundato; aperturâ parum obliquâ, ovali; peristomate interrupto, simplice, recto, margine columellari perarcuato, subincrassato.—Operculum?*
Diam. maj. 7, min. 6, alt. 6 mill.
Hab. in insulâ Rapâ Oceani pacifici.

11. Cyclostoma (Leptopoma) latelimbatum, Pfr. *C. testâ perforatâ, globoso-conicâ, tenui, minutè spiraliter striatâ et lineis obtusis elevatis, subæquidistantibus cinctâ, diaphanâ, parum nitidâ, albâ, maculis et fasciis pallidè fulvis variegatâ; spirâ turbinatâ, acutiusculâ; anfractibus* 5, *convexiusculis, ultimo rotunduto, medio lineâ acutè elevatâ subcarinato; umbilico angusto, vix pervio; aperturâ obliquâ, subcirculari; peristomate duplice, albo: interno interrupto, breviter porrecto, marginibus callo tenui junctis, externo undique æqualiter dilatato, angulatim patente, supra perforationem exciso.—Operculum?*
Diam. maj. 17, min. 13, alt. 11 mill.
Hab. in insulis Philippinis.

12. Cyclostoma (Leptopoma) regulare, Pfr. *C. testâ angustissimè perforatâ, conicâ, globosâ, tenui, lineis approximatis supernè æqualibus sculptâ, interstitiis spiraliter confertim striatâ, diaphanâ, albidâ, maculis fulvidis regulariter tessellatâ; spirâ turbinatâ, apice acutâ, pallidè corneâ, anfractibus* $5\frac{1}{2}$, *convexiusculis, ultimo convexiore, infra liram periphericam inflato, obsoletius lirato; aperturâ obliquâ, lunato-circulari; peristomate interrupto, tenui, albo, breviter patente, margine columellari basi subangulatim dilatato. Operculum?*
Diam. maj. $12\frac{1}{2}$, min. 10, alt. 10 mill.

13. Cyclostoma (Leptopoma) sericatum, Pfr. *C. testâ perforatâ, globoso-conicâ, tenui, pellucidâ, sericeâ, lineis obliquis, subdistantibus sculptâ, supernè lineis* 4–5 *elevatis, spiralibus munitâ, hyalino-albidâ, liris corneis (vel undique violacescenti-fulvâ, basi pallidiore); spirâ turbinatâ, acutâ, apice nigricante; anfractibus* 5, *superis parum convexis, ultimo inflato, subcarinato, infra carinam fasciâ unicâ castaneâ ornato, basi liris spiralibus nonnullis obsoletioribus sculpto; umbilico angustissimo, non pervio; aperturâ parum obliquâ, subemarginato-circulari; peristomate simplice, interrupto, tenui, horizontaliter patente, margine columellari medio sublingulatim dilatato.—Operculum?*
Diam. maj. 12, min. vix 10, alt. 9 mill.
Hab. in insulâ Borneo (Taylor).

14. Cyclostoma pleurophorum, Pfr. *C. testâ umbilicatâ, globoso-turbinatâ, tenui, longitudinaliter confertè striatâ et costulis filaribus, prominentioribus sculptâ, diaphanâ, parum nitidâ, albido-fulvescente; spirâ turbinatâ, apice acutiusculâ, corneâ; suturâ costis denticulatâ; anfractibus* 5, *convexis, ultimo subterete, anticè*

breviter soluto; umbilico mediocri, profundo, angulo cariniformi cincto; aperturâ subverticali, ovato-subcirculari; peristomate continuo, simplice, recto, margine columellari expansiusculo.—Operculum duplex, lamina externa testacea, 5-spiratâ, marginibus anfractuum liberis, interna planâ, cartilagineâ.
Diam. maj. 11, min. $9\frac{2}{3}$, alt. $9\frac{3}{4}$ mill.
Hab. Honduras.

15. Cyclostoma fasciculare, Pfr. *C. testâ perforatâ, acuminato-ovatâ, solidulâ, confertissimè costulato-striatâ, vix sericeâ, griseo-corneâ; spirâ conicâ, acutiusculâ; suturâ costularum fasciculis crenatâ; anfractibus 5, convexiusculis, ultimo rotundato, basi spiraliter sulcato; aperturâ vix obliquâ, ovali; peristomate simplice, recto, acuto.—Operculum terminale, testaceum, planum, paucispirum, anfractibus obliquè striatis.*
Long. 12, diam. 8 mill.
Hab. ——?

16. Cyclostoma Guatemalense, Pfr. *C. testâ perforatâ, oblongâ, solidulâ, subtruncatâ, striatulâ, olivaceo-fuscâ; spirâ convexiusculo-turritâ; anfractibus 6, parum convexis, ultimo angustiore, anticè descendente, breviter soluto, basi, circa perforationem apertam, compresso, nec carinato; aperturâ verticali, subcirculari; peristomate libero, albo, duplice: interno continuo, vix porrecto, externo dilatato, horizontaliter expanso, supra perforationem exciso.—Operculum?*
Long. 24, diam. 8 mill.
Hab. Vera Paz in Guatemalâ.

17. Cyclostoma canescens, Pfr. *C. testâ subperforatâ, oblongo-turritâ, truncatulâ, solidâ, lineis longitudinalibus et spiralibus elevatis regulariter clathratâ, parum nitidâ, griseo-albidâ; spirâ elongatâ; suturâ tuberculis confertis, albis crenatâ; anfractibus superstomate 7, vix convexiusculis, ultimo basi attenuato, circa perforationem obsoletam distinctius spiraliter sulcato; aperturâ verticali, angulato-ovali, intus fusco-carneâ; peristomate duplice: interno vix porrecto, externo undique breviter expanso, supernè angulato, anfractui penultimo breviter adnato.—Operculum?*
Long. 20, diam. 7 mill.
Hab. ——?

18. Cyclostoma violaceum, Pfr. *C. testâ subobtectè perforatâ, ovato-turritâ, truncatâ, solidulâ, lineis elevatis spiralibus et confertioribus longitudinalibus oblongo-granulatâ, haud scabrâ, non nitente, saturatè violaceâ; spirâ turritâ, truncatâ; anfractibus superstomate $4\frac{1}{2}$, convexis, ultimo rotundato; aperturâ subverticali, ovali; peristomate simplice, albo, continuo, margine dextro subincrassato, angustè angulatim patente, columellari in laminam sinuosam, perforationem occultantem, nec claudentem, dilatato.—Operculum immersum, testaceum, planum, cinereum, paucispirum.*
Long. 20, diam. 11 mill.
Hab. ——?

19. Cyclostoma Shuttleworthi, Pfr. *C. testâ clausè umbilicatâ, oblongâ, truncatâ, spiraliter confertim plicatâ, lineis longitudinalibus obsoletè decussatâ, sericeâ, pallidissimè fulvidâ, fasciis valdè interruptis castaneis ornatâ; spirâ oblongâ; anfractibus superstomate* 3, *convexiusculis, ultimo basi rotundato; aperturâ verticali, angulato-ovali; peristomate duplice: interno brevi, expansiusculo, externo latè patente, concentricè striato, radiatim plicato et castaneo-radiato, ad columellam exciso, laminâ albâ fornicatâ umbilicum prorsus claudente.—Operculum terminale, cartilagineum, paucispirum, nucleo basali.*

Long. 22, diam. 11½ mill.

Hab. in insulâ Cubâ.

20. Cyclostoma radula, Pfr. *C. testâ perforatâ, ovato-oblongâ, truncatâ, tenui, lineis elevatis spiralibus et costis acutis longitudinalibus subtiliter asperato-decussatâ, pallidè corneâ, fasciis angustis, rufis, interruptis ornatâ, non nitente; spirâ sursum attenuatâ, latè truncatâ; suturâ profundâ, subsimplice; anfractibus superstomate* 4, *convexis, ultimo angustiore, rotundato; aperturâ verticali, circulari; peristomate duplice: interno continuo, vix porrecto, externo dilatato, horizontaliter patente, concentricè striato, ad anfractum penultimum subexciso, margine sinistro fimbriato-inciso.—Operculum planum, e duabus laminis compositum, externâ subtestaceâ, anfractibus* 3½, *nucleo subcentrali.*

Long. 14, diam. 7 mill.

Hab. Almendares prope Havana.

21. Cyclostoma ovatum, Pfr. *C. testâ obtectè perforatâ, oblongo-ovatâ, truncatâ, tenui, longitudinaliter confertim plicatulâ, sericeâ, fusco-corneâ, vel pallidissimè corneâ, maculis rufis seriatim dispositis ornatâ; spirâ ovato-conicâ, truncatâ; suturâ levi, irregulariter tuberculato-crenatâ; anfractibus superstomate* 5, *convexiusculis, ultimo paulo angustiore, basi obsoletè spiraliter sulcato; aperturâ verticali, rotundato-ovali; peristomate fusculo, duplice: interno breviter porrecto, externo undique dilatato, campanulato-expanso, radiato-costato, supernè angulatim reflexo, anfractui penultimo longè adnato, perforationem claudente, margine sinistro subauriculato, libero.—Operculum?*

Long. 17½, diam. 8 mill.

Hab. in insulâ Cubâ.

22. Cyclostoma Grateloupi, Pfr. *C. testâ perforatâ, oblongâ, pupiformi, truncatâ, tenuiusculâ, spiraliter confertim sulcatâ et costis longitudinalibus, confertis, non interruptis sculptâ, diaphanâ, parum nitidâ, corneo-albidâ, fasciis strigatim interruptis castaneis ornatâ; spirâ sursum parum attenuatâ, latè truncatâ; suturâ levi, crenatâ: crenis supernè minutis, confertis, in anfractibus ultimis fasciculatim dilatatis, obtusis; anfractibus superstomate* 4, *vix convexiusculis, ultimo anticè breviter soluto, basi rotundato; aperturâ verticali, ovali; peristomate duplice: interno breviter expanso, adnato, externo campanulato-patente, rufo radiato, supernè*

cucullatim elevato, tum emarginato et anfractui penultimo adnato.—Operculum testaceum, planum, anfractibus 3, *marginibus lamellosoliberis.*

Long. 16, diam. 7 mill.

β. T. minor, crenulis suturæ confertis, acutis.

Hab. Yucatan, var. *β.* in Indiâ occidentali.

23. Cyclostoma histrio, Pfr. *C. testâ profundè rimatâ, ovato-conicâ, solidiusculâ, longitudinaliter confertim plicatâ, parum nitidâ, albidâ, strigis latis obliquis, angulosis, fuscis pictâ; spirâ elato-conicâ, vix truncatulâ; suturâ supernè minutè denticulatâ, anfractuum inferiorum subsimplice; anfractibus* $4\frac{1}{2}$, *convexis, ultimo rotundato, basi ultra axin subproducto; aperturâ subobliquâ, subcirculari, intus nitidâ, fulvidâ, nebulosâ; peristomate laterito, duplice: interno continuo, latè expanso, appresso, externo latiore, horizontaliter patente, supernè sinuato-angulato, ad anfractum penultimum breviter interrupto.—Operculum?*

Long. 20, diam. 11 mill.

Hab. in insulâ Jamaicâ.

24. Cyclostoma integrum, Pfr. *C. testâ perforatâ, turritâ, tenuiusculâ, integrâ, lineis obsoletè elevatis spiralibus et costulis confertis longitudinalibus (tertiâ vel quartâ quâvis validiore) subdecussatâ, fulvidâ, fasciis interruptis rufis cingulatâ; spirâ regulariter turritâ, apice obtusiusculâ; suturâ subconfertè denticulatâ; anfractibus* 7, *convexis,* 2 *primis lævigatis, ultimo rotundato, antrorsum breviter soluto, vix descendente, basi rotundato, fasciis* 2–3 *continuis rufis ornato; aperturâ vix obliquâ, ovali; peristomate subduplicato: interno continuo, adnato, externo patente, supernè subangulato-dilatato, tum emarginato, latere columellari undulato.—Operculum cartilagineum, planum, paucispirum.*

Long. 12, diam. 5 mill.

Hab. in Indiâ occidentali.

25. Cyclostoma harpa, Pfr. *C. testâ breviter rimatâ, oblongo-turritâ, tenuiusculâ, plicis longitudinalibus chordiformibus subdistantibus munitâ, cinnamomeo-carneâ, haud nitente, lineis rufis strigatim interruptis ornatâ; spirâ turritâ, integrâ, sursum nigro-violaceâ, apice obtusâ; suturâ profundâ, plicis prominentibus subcrenatâ; anfractibus* 6, *convexis, ultimo rotundato; aperturâ verticali, ovali-subcirculari; peristomate rubello, duplice: interno expansiusculo, appresso, externo undique vix dilatato-patente, anfractui penultimo breviter adnato.—Operculum?*

Long. 12, diam. 6 mill.

Hab. Almendares prope Havana.

26. Cyclostoma pingue, Pfr. *C. testâ umbilicatâ, oblongo-turritâ, truncatâ, solidâ, liris spiralibus obtusis undulatâ, striis longitudinalibus confertissimis sculptâ, oleoso-micante, cinnamomeo-fuscâ; suturâ profundâ, simplice; anfractibus superstomate* 4, *convexis, regulariter accrescentibus, ultimo rotundato; aperturâ subverticali, ferè circulari; peristomate albo, duplice: interno*

expansiusculo, adnato, externo continuo, horizontaliter expanso, anfractui penultimo brevissimè adnato, supernè angulato.—Operculum?

Long. $12\frac{1}{2}$, diam. 6 mill.

Hab. —— ?

27. Cyclostoma pallidum, Pfr. *C. testâ perforatâ, ovato-turritâ, truncatâ, tenui, lineis elevatis spiralibus et confertissimis longitudinalibus (hic illic irregularibus, subconfluentibus) minutè decussatâ, pallidè corneâ, lineolis rufis interruptis obsoletè pictâ; suturâ profundâ, subsimplice; anfractibus superstomate 4, convexis, ultimo rotundato; aperturâ verticali, ovali-circulari; peristomate duplice, interno albo, porrecto, expansiusculo, externo dilatato, horizontaliter patente, concentricè striato, anfractui penultimo breviter adnato, margine sinistro angustiore.—Operculum terminale, testaceum, anfractibus $3\frac{1}{2}$, obliquè striatis, marginibus subliberis.*

Long. $17\frac{1}{2}$, diam. $8\frac{1}{2}$ mill.

Hab. Almendares prope Havana.

28. Cyclostoma Cumanense, Pfr. *C. testâ perforatâ, turrito-oblongâ, truncatâ, tenui, longitudinaliter confertim plicatâ, sericeâ, pellucidâ, corneo-lutescente, maculis castaneis fasciatim dispositis ornatâ; suturâ plicis excurrentibus confertim subcrenatâ; anfractibus superstomate 5, subconvexis, ultimo basi rotundato, anticè breviter soluto, dorso carinato; aperturâ subverticali, ovali, supernè subangulatâ; peristomate libero, simplice, undique vix expanso.—Operculum cartilagineum, planum, paucispirum.*

Long. 15, diam. $7\frac{1}{2}$ mill.

29. Cyclostoma turritum, Pfr. *C. testâ subperforatâ, turritâ, truncatulâ, lineis elevatis spiralibus et longitudinalibus regulariter clathratâ, albidâ, lineolis rufis interruptis cinctâ; suturâ subprofundâ, confertim denticulatâ; anfractibus superstomate 6, convexiusculis, regulariter accrescentibus, ultimo rotundato; aperturâ verticali, ovali, intus fulvidâ; peristomate subduplice: interno continuo, expansiusculo, externo supernè angulatim dilatato, margine dextro vix patente, columellari et sinistro exciso.—Operculum?*

Long. 16, diam. 7 mill.

Hab. Honduras (Mr. Dyson).

30. Cyclostoma diaphanum, Pfr. *C. testâ subperforatâ, oblongo-turritâ, truncatâ, tenuiusculâ, lineis elevatis spiralibus confertis, costulisque illas transgredientibus filaribus confertioribus decussatâ, diaphanâ, unicolore albidâ; spirâ elongatâ; suturâ irregulariter crenatâ; anfractibus superstomate $4\frac{1}{2}$, convexis, subæqualibus, ultimo anticè soluto, dorso carinato, basi rotundato, distinctius spiraliter sulcato; aperturâ verticali, angulato-ovali; peristomate subsimplice, continuo, undique breviter expanso.—Operculum?*

Long. 12, diam. 5 mill.

Hab. —— ?

31. Cyclostoma lugubre, Pfr. *C. testâ perforatâ, turrito-oblongâ, solidâ; truncatâ, liris obtusis spiralibus, costulisque submembranaceis illas transgredientibus sculptâ, fusculâ, violaceo-fusco latè unifasciatâ; spirâ parum attenuatâ; suturâ confertim et subacutè fasciculato-crenatâ; anfractibus superstomate* 5, *convexiusculis, ultimo anticè breviter soluto, subdescendente, dorso compresso, basi distinctius spiraliter lirato; aperturâ verticali, obliquè ovali; peristomate subsimplice, continuo, margine sinistro breviter, reliquis paulò latius expansis, subundulatis.—Operculum?*
Long. 16, diam. ferè 7 mill.
Hab. in insulâ Jamaicâ.

32. Cyclostoma Kusteri, Pfr. *C. testâ perforatâ, ovato-turritâ, truncatâ, tenui, sulcis spiralibus et costulis longitudinalibus confertis regulariter granulato-reticulatâ, vix nitente, diaphanâ, fusco-corneâ, lineis obsoletis rufis interruptis pictâ; spirâ convexo-turritâ, latè truncatâ; suturâ profundâ, simplice; anfractibus superstomate* 4, *convexis, ultimo angustiore, rotundato; aperturâ subverticali, subcirculari; peristomate duplice: interno breviter expanso, adnato, externo campanulato-expanso, concentricè striato, anticè concavo, rufo-radiato, supernè angulato, ad anfractum penultimum angustato.—Operculum?*
Long. 14, diam. 7 mill.
Hab. Honduras (Mr. Dyson).

33. Cyclostoma trochlea, Pfr. *C. testâ perforatâ, oblongo-turritâ, truncatâ, costis filaribus spiralibus et longitudinalibus subregulariter clathratâ, haud nitente, pallidè fusculâ, punctis rufis subseriatis variegatâ; spirâ elongatâ, trochleari, latè truncatâ; suturâ profundâ, simplice; anfractibus superstomate* 5, *perconvexis; aperturâ verticali, subcirculari; peristomate duplice: interno vix porrecto, externo horizontaliter expanso, supernè in rostrum recurvatum dilatato, ad anfractum penultimum breviter interrupto, latere sinistro inciso-crenulato.—Operculum?*
Long. 14, diam. 6 mill.
Hab. ——?

34. Cyclostoma alternans, Pfr. *C. testâ mediocriter umbilicatâ, conoideo-depressâ, tenuiusculâ, acutè multiliratâ, liris alternis minoribus, haud nitente, subepidermide pallidè lutescente fugace albâ; spirâ breviter conoideo-elevatâ, obtusiusculâ; suturâ subcanaliculatâ; anfractibus* 5, *convexiusculis, ultimo rotundato; aperturâ parum obliquâ, subcirculari; peristomate simplice, recto, fusco-limbato, subcontinuo, marginibus ad anfractum penultimum callo nitido junctis.—Operculum membranaceum, planum, cereum, arctispirum.*
Diam. maj. 20, min. 16, alt. 10 mill.
Hab. Madagascar.

35. Cyclostoma rusticum, Pfr. *C. testâ latè umbilicatâ, depressâ, subdiscoideâ, solidâ, spiraliter confertim liratâ, non nitente, sordidè albidâ, pallidè fusculo irregulariter variegatâ; spirâ parum*

elevatâ, vertice submucronato; anfractibus $4\frac{1}{2}$, *convexiusculis, ad suturam subdepressis, ultimo terete, anticè descendente; aperturâ diagonali, subcirculari, intus carneâ; peristomate simplice, breviter expanso, marginibus callo brevi junctis, supero repando.—Operculum?*

Long. maj. $17\frac{1}{2}$, min. $13\frac{1}{2}$, alt. $7\frac{1}{2}$ mill.

Hab. —— ?

36. Cyclostoma psilomitum, Pfr. *C. testâ mediocriter umbilicatâ, depresso-conoideâ, solidulâ, virenti-luteâ, vix nitidulâ, lineis spiralibus subtilissimis, piloso-elevatis crebris obscurioribus cinctâ; spirâ breviter conoideâ, obtusâ; suturâ subcanaliculatâ; anfractibus 4, convexis, ultimo terete, non descendente; aperturâ ferè verticali, subcirculari, intus albidâ; peristomate simplice, acuto, marginibus ferè contiguis, callo brevi junctis.—Operculum?*

Diam. maj. 15, min. 11, alt. 8 mill.

Hab. Venezuela.

37. Cyclostoma alatum, Pfr. *C. testâ latè umbilicatâ, conoideo-depressâ, solidulâ, obliquè confertim et inæqualiter costulatâ, vix diaphanâ, albidâ, fasciis angustis pallidissime corneis variegatâ; spirâ brevissime conoideâ, acutiusculâ; suturâ simplice; anfractibus 4, modicè convexis, ultimo subterete, anticè vix descendente, lilaceo-nebuloso; aperturâ diagonali, subcirculari, intus lilaceo-fusculâ; peristomate subduplice, latere dextro et basali connato, expanso, externo supernè alatim dilatato, latere sinistro subreflexo. —Operculum?*

Diam. maj. 16, min. 13, alt. 8 mill.

Hab. S. Yago de Cuba.

38. Cyclostoma scalare, Pfr. *C. testâ angustè umbilicatâ, conoideâ, solidulâ, obliquè striatulâ, nitidulâ, corneo-luteâ; spirâ elatâ, scalari, apice acutâ; suturâ profundâ; anfractibus* $4\frac{1}{2}$, *perconvexis, ultimo terete, anticè subsoluto; aperturâ obliquâ, circulari, intus margaritaceâ; peristomate simplice, continuo, undique vix expansiusculo.—Operculum?*

Diam. maj. 9, min. 7, alt. $6\frac{1}{2}$ mill.

Hab. in insulis Philippinis.

39. Cyclostoma (Cyclophorus) lutescens, Pfr. *C. testâ umbilicatâ, depresso-conoideâ, solidâ, obliquè filoso-striatâ, sericeâ, fusco-lutescente; spirâ breviter conoideâ, apice acutiusculâ; suturâ profundâ, simplice; anfractibus* $4\frac{1}{2}$, *convexis, rapide accrescentibus, ultimo non descendente; umbilico mediocri, profundo; aperturâ vix obliquâ, rotundato-ovali; peristomate simplice, recto, acuto, continuo, breviter adnato, supernè vix angulato.—Operculum membranaceum, pallidè corneum, rectispirum, extus profundè concavum.*

Diam. maj. 20, min. $15\frac{1}{2}$, alt. 12 mill.

Hab. in Brasiliâ.

40. Cyclostoma guttatum, Pfr. *C. testâ umbilicatâ, depressâ, solidâ, glabrâ, nitidâ, lætè castaneâ, maculis albis subtriangulari-*

bus guttatâ; spirâ vix elevatâ, apice fuscâ, submucronatâ; anfractibus $4\frac{1}{2}$, *convexiusculis, celeriter crescentibus, ad suturam impressam striatulis; umbilico latiusculo, pervio; aperturâ parum obliquâ, circulari, intus albidâ; peristomate subduplice: interno vix distinguendo, externo expanso, supernè in linguam brevem, anfractui penultimo adnatam, dilatato.—Operculum?*

Diam. maj. 19, min. 15, alt. 9 mill.

Hab. ——?

41. Cyclostoma ignescens, Pfr. *C. testâ perforatâ, globoso-conicâ, tenui, lineis spiralibus subtilissimis confertim sculptâ, diaphanâ, nitidâ, ignescente; spirâ turbinatâ, obtusiusculâ; suturâ profundâ; anfractibus* $4\frac{1}{2}$, *convexis, ultimo basi distinctius sulcato; aperturâ obliquâ, subcirculari; peristomate simplice, expanso, marginibus approximatis, non junctis.—Operculum?*

Diam. maj. 14, min. 11, alt. $11\frac{1}{2}$ mill.

Hab. in Novâ Hiberniâ.

42. Cyclostoma fusculum, Pfr. *C. testâ angustissime umbilicatâ, globoso-conicâ, tenui, lineis elevatis spiralibus subconfertis, liráque peripherica validiore cariniformi sculptâ, vix nitidulâ, unicolore fusculâ, fasciâ unicâ angustâ rufâ infra carinam pallidam ornatâ; spirâ conicâ, obtusiusculâ; anfractibus* 5, *convexis, ultimo interdum carinâ, secundo superne notato, basi minute spiraliter sulcato; aperturâ parum obliquâ, rotundato-ovali; peristomate simplice, tenui, undique expansiusculo, marginibus approximatis, non junctis.—Operculum testaceum, planum, cinereum, 4-spirum, nucleo subcentrali.*

Diam. maj. $11\frac{1}{2}$, min. $9\frac{1}{2}$, alt. 9 mill.

Hab. ——?

43. Cyclostoma castaneum, Pfr. *C. testâ angustè umbilicatâ, globoso-conicâ, tenui, obliquè striatulâ et liris subacutis multis sculptâ, nitidâ, saturatè castaneâ; spirâ elevato-conicâ, apice obtusiusculâ; anfractibus* $4\frac{1}{2}$, *angulato-convexis, ultimo liris* 6 *subæqualibus, pluribusque minoribus, confertioribus in umbilico munito; aperturâ parum obliquâ, subcirculari; peristomate simplice, tenui, undique expansiusculo, marginibus approximatis, non junctis. —Operculum testaceum, planum, paucispirum, nucleo subcentrali.*

Diam. maj. 11, min. 9, alt. 9 mill.

Hab. in insulâ Madagascar.

LINNÆAN SOCIETY.

May 3, 1853.—R. Brown, Esq., President, in the Chair.

Read, a memoir "On the Vegetation of Buenos Ayres and the neighbouring districts." By Charles James Fox Bunbury, Esq., F.R.S., F.L.S., &c.

Mr. Bunbury commences his memoir by an indication of the sources from which his notes are principally derived, consisting chiefly of very extensive collections made by the late Mr. Fox (for-

merly British Minister at Buenos Ayres, and afterwards at Rio de Janeiro) in the neighbourhood of Buenos Ayres, Monte Video, Maldonado, and other localities on the northern shore of the Rio de la Plata, and along the lower part of the River Uruguay, aided by a residence of about a month at Buenos Ayres in the beginning of 1834, during which he had himself the opportunity of becoming acquainted with the most prominent features and general aspect of the vegetation. The principal published works which he has consulted are M. Auguste de St. Hilaire's 'Report of his Travels in Southern Brasil' (in the ninth volume of the 'Mémoires du Muséum d'Histoire Naturelle'), and the papers by Sir William Hooker and Dr. Walker-Arnott "On the Plants of Extratropical South America," in the 'Botanical Miscellany' and 'Journal of Botany;' and he also acknowledges his obligations to Sir William Hooker for very important assistance in naming the specimens contained in Mr. Fox's collections.

The region of which he proposes to treat is defined as lying on both banks of the Rio de la Plata, and on the lower part of the courses of the two great rivers by whose junction it is formed; and consequently comprises those parts of the republics of Buenos Ayres and the Banda Oriental which lie nearest to the Plata, between the parallels of 33° and 35° S. lat. The collections were chiefly formed in the neighbourhood of the coasts and of the rivers. Mr. Fox also made large collections in the southernmost part of Brasil; on the vegetation of which Mr. Bunbury proposes occasionally to remark, as forming a connecting link, botanically as well as geographically, between the Buenos-Ayrean districts and the tropical parts of the same continent. Geologically the Rio de la Plata (which as far up as Buenos Ayres is between twenty and thirty miles wide) forms a strongly marked boundary, separating two widely extended and very dissimilar formations. All its northern shore is composed of crystalline rocks (granite and gneiss, and their various modifications), which range from thence to the northward uninterruptedly through many degrees of latitude, constituting the whole coast of Brasil, even it is said as far as Bahia. On the south of the great river nothing is seen but tertiary formations of a very late date; first, the mud and marl of the Pampas, and further south the gravel and shingle of Patagonia. The line of demarcation between these two formations is absolute; but notwithstanding this remarkable difference in the structure of its banks, the Plata does not form a botanical boundary. There are indeed several species of plants which are confined to one side or the other, and some families (principally tropical) which do not cross it; yet the leading characteristics of the vegetation, both as to its general physiognomy and its prevailing forms, are the same on both sides. The whole country, therefore, from the frontier of Brasil southward, as far as the Pampas vegetation extends (or to the border of Patagonia), may be considered as one botanical province, which, for the sake of convenience, Mr. Bunbury provisionally calls the *Argentine* region, from the name of the great river.

The botanical characteristics of this region are well-marked; its most striking peculiarity consists in the almost entire absence of trees, and the scarcity even of shrubs except along the banks of the principal rivers. Every one who has come from Rio de Janeiro to Monte Video and Buenos Ayres has been struck by the contrast between the gigantic vegetation of Brasil and the bare, treeless, almost barren character of the shores of the Plata, where the cultivated Poplars, and the flower-stalks of the *Agave*, with here and there a solitary Ombù tree (*Phytolacca dioica*), are the only objects that relieve the nakedness of the country. It is not that the vegetable covering of the soil is really scanty; but the vast majority of the plants which compose it are herbaceous, of low growth, and for the most part not very conspicuous. This treeless character has been forcibly described, and its possible causes most ably discussed, by Mr. Darwin in his 'Journal.' The immediate banks of the Uruguay and Paranà, however, and the islands in those rivers, appear to be wooded, although not with trees of great height or size. As compared with Brasil, the vegetation of the Argentine region is further distinguished (as might be expected) by the diminished numbers of tropical families, and also by something of a more European physiognomy. The resemblance in this particular appears, however, to Mr. Bunbury to be not so great as has been represented, being in a great measure due to the abundance of naturalized European plants; and excluding these, to consist rather in a certain general similarity of character than in a real botanical analogy. Schouw's estimate, that out of 109 genera which belong to Buenos Ayres, 70 appear in Europe, and St. Hilaire's statement, that of 500 species collected by him in the Banda Oriental, only 15 belonged to families completely strangers to Europe, are doubtless accurate so far as they go; but the vegetation of these countries is really more different from the European than such comparisons would seem to imply. For, in the first place, many families and genera, which are strikingly characteristic of the Argentine region, are but scantily represented in Europe. Such, in particular, are the families of *Solaneæ*, *Verbenaceæ*, *Amaranthaceæ*, and perhaps *Malvaceæ*. Of the genus *Solanum*, for instance, many more species grow wild within a short walk of Buenos Ayres than in the whole of Europe. The genus *Verbena*, again, so insignificant in Europe, plays a conspicuous part in the Argentine vegetation by the number of its species, the profusion in which they grow, and their general brilliancy and beauty. Secondly, although the genera altogether wanting in Europe may not form numerically a very large proportion of the Argentine Flora, yet several of them are very conspicuous, and play an important part in that Flora by the number of species or of individuals: such are *Pontederia*, *Gomphrena*, *Teleianthera*, *Jussiæa*, *Nicotiana*, *Petunia*, *Nierembergia*, and others. Thirdly, several families which most abound in Europe are nearly wanting, or but very feebly represented (if we exclude naturalized plants) on the shores of the Plata: such are *Cruciferæ*, *Caryophylleæ*, *Umbelliferæ* (excepting *Eryngium*), *Borragineæ*, *Dipsaceæ*, *Cichoraceæ* and *Cy-*

nareæ. In the collections in his possession from Buenos Ayres and the Banda Oriental, Mr. Bunbury finds 14 families and 102 genera which are not European. The families are *Commelynaceæ*, *Pontederaceæ*, *Bromeliaceæ*, *Marantaceæ*, *Calycereæ*, *Bignoniaceæ*, *Passifloreæ*, *Loaseæ*, *Begoniaceæ*, *Buttneriaceæ*, *Malpighiaceæ*, *Sapindaceæ*, *Tropæoleæ* and *Melastomaceæ*. The genera (adopting Endlicher's 'Genera Plantarum' as the guide) are *Paspalum*, *Stenotaphrum*, *Cenchrus*, *Aristida*, *Chascolytrum*, *Pappophorum*, *Eustachys*, *Eleusine*, *Androtrichum*, *Commelyna*, *Hydrocleis*, *Pontederia*, *Herreria*, *Udora*, *Sisyrinchium*, *Cypella*, *Alstrœmeria*, *Tillandsia*, *Oncidium*, *Canna*, *Spathicarpa*, *Roubieva*, *Gomphrena*, *Teleianthera*, *Pupalia*, *Iresine*, *Acicarpha*, *Boopis*, *Vernonia*, *Stevia*, *Baccharis*, *Pterocaulon*, *Haplopappus*, *Flaveria*, *Porophyllum*, *Leighia*, *Verbesina*, *Achyrocline*, *Trixis*, *Mitracarpum*, *Cephalanthus*, *Asclepias*, *Gomphocarpus*, *Oxypetalum*, *Araujia*, *Philibertia*, *Schistogyne*, *Lantana*, *Calonyction*, *Nicotiana*, *Nierembergia*, *Petunia*, *Jaborosa*, *Himeranthus*, *Cestrum*, *Buddlea*, *Scoparia*, *Herpestes*, *Dicliptera*, *Bignonia*, *Argemone*, *Passiflora*, *Blumenbachia*, *Begonia?*, *Pavonia*, *Sida*, *Abutilon*, *Buttneria*, *Stigmaphyllum*, *Heteropterys*, *Paullinia*, *Croton*, *Phyllanthus*, *Schinus*, *Chymocarpus*, *Jussiæa*, *Heimia*, *Cuphea*, *Eugenia*, *Chætogastra*, *Mimosa*, *Desmanthus*, *Inga*, *Calliandra*, *Acacia*, *Parkinsonia*, *Cassia*, *Poinciana?* (perhaps introduced), *Crotalaria*, *Indigofera*, *Tephrosia*, *Daubentonia*, *Desmodium*, *Æschynomene*, *Clitoria*, *Camptosema*, *Canavalia*, *Galactia*, *Vigna*, *Erythrina?* (perhaps introduced), *Rhynchosia*, *Machærium*. These lists are sufficient to show how materially the Argentine Flora differs from that of Europe; but what chiefly contributes to give it at first sight a European character is the great number and extraordinary prevalence of naturalized European plants, which have spread so rapidly as to cover the soil to a great extent, and actually to predominate over the native growth. The fallow fields about Buenos Ayres are blue with *Echium violaceum*; the banks are covered with the common Fennel; the ditch-sides and waste grounds are overrun with *Chenopodium album*, *Sonchus oleraceus* and *Xanthium spinosum*; *Trifolium repens* and *Medicago denticulata* form much of the herbage near the river-side; and among the most common grasses are *Lolium perenne*, *L. multiflorum*, *Hordeum murinum* and *H. pratense*. And these intrusive strangers are not confined to the cultivated lands or to the neighbourhood of the city; the "thistles" and "clover," which clothe the Pampas of Buenos Ayres for leagues and leagues together, are *Carduus Marianus*, *Cynara Cardunculus* and *Medicago denticulata*, all of European origin. It is, as Mr. Darwin remarks, a parallel case to that of the horse and ox, which have, within the last three centuries, spread themselves in such countless numbers over the same countries. Mr. Bunbury regards this wide diffusion of naturalized plants as adverse to the views of those who consider the natural distribution of species as determined solely by favourable local circumstances; the circumstances in the present instance being evidently highly favourable to the plants in question, which

however did not exist in these countries until introduced by the indirect agency of man.

The social character, so eminently conspicuous in many of the naturalized plants, is observable also, though in a less degree, in several of the indigenous plants of the Pampas of Buenos Ayres, the most remarkable cases observed being *Verbena erinoides*, *V. chamædryfolia*, *Mitracarpum Sellovianum*, and a dwarf *Solanum*, besides a few grasses. This social growth of some particular plants, and the consequent uniformity of vegetation, has, Mr. Bunbury thinks, been before noticed as characteristic of extensive plains. Tropical forms of vegetation occur chiefly on the banks and islands of the principal rivers. They are principally woody climbers, such as *Passiflora cærulea*, *Stigmaphyllum littorale*, two or three species of *Paullinia*, a *Cardiospermum* and a *Bignonia*; or *Leguminosæ* of a tropical character, species of *Mimosa*, *Inga*, *Calliandra* and *Cassia*. One solitary species of *Melastomaceæ* (an *Arthrostemma*) reaches to the north bank of the Plata, but does not cross it. One *Machærium* grows in the islands of the Uruguay near its mouth. A few monocotyledonous genera, which have their head-quarters within the tropics, appear for the last time on the banks of the Plata; such are *Canna*, *Oncidium* and *Tillandsia*. Palms, it would appear from Mr. Darwin's statements, occur here and there as far as 35° S. lat., which seems to be likewise their southern limit in Chile.

The southern limit of the Argentine vegetation seems to be determined mainly by soil, the northern by climate alone. Where the calcareous mud and marl of the Pampas are succeeded by the arid gravel or shingle of Patagonia, that is to say about the Rio Colorado, in 40° S. lat., Mr. Darwin notices the change in the vegetable covering of the soil, accompanying this change in its mineral nature. The herbaceous vegetation, which clothes the surface of the Pampas pretty uniformly, is succeeded by low, scraggy, thorny shrubs and dry meagre grasses, so thinly scattered over the shingly plains of Patagonia, that their aspect is strikingly barren and miserable. That this change of soil should be attended with so great a change in the vegetation, while that (more striking in a geological view) which takes place when we cross the Plata seems to have very little influence on it, is easily accounted for by the different relation of these soils to moisture. The loose shingly soil of Patagonia is so singularly dry, as to be fitted only for those plants which can bear an extraordinary degree of drought; while the clay and marl of the Pampas, and the decomposing granite of the north side of the Plata, are both sufficiently favourable to the retention of moisture, and consequently to the growth of an abundant herbage.

To the northward the Argentine region appears to melt as it were insensibly into that of Southern Brasil. About Porto Alegre, in S. lat. 30°, and consequently little more than 4° north of Buenos Ayres, the botany has a thorough Brasilian character, notwithstanding the absence of great forests. The numerous ferns of Rio Grande are almost all common to that district and to Rio de Janeiro. Not a few tropical phænogamous species also extend as far as Porto

Alegre, while others range still further south to Monte Video. On the other hand, the comparatively small number of *Melastomaceæ*, and the abundance of herbaceous and half-shrubby *Verbeneæ* in Rio Grande, indicate the approach to the Argentine region. The considerable difference between the vegetation of Porto Alegre and of the northern shore of the Plata, Mr. Bunbury conceives to be due to climate alone; and the fact mentioned by M. Auguste de St. Hilaire, that the cultivation of mandiocca and sugar extends as far south as Porto Alegre, and no further, seems to point it out as the southernmost limit of the seasons of tropical Brasil.

For a comparison of the Flora of Chile with that of the Argentine region, Mr. Bunbury regrets that he has not sufficient materials. Meyen indeed states, that Chile, and the countries on the eastern side of the Andes in corresponding latitudes, cannot be considered as separate botanical regions; yet the information which he himself gives as to the Chilian Flora, seems to show that its general physiognomy is very different from the Argentine. The accounts of many travellers show the climate and soil of Chile to be much more dry; and the Chilian Flora appears to be as strikingly characterized by dry shrubs with coriaceous and glossy leaves, as that of the Plata by the prevalence of herbaceous forms. In the abundance of Myrtles, indeed, and of shrubby and arborescent *Compositæ*, the vegetation of Chile may be compared rather with that of Southern Brasil. At the same time the valuable catalogues drawn up by Sir William Hooker and Dr. Walker-Arnott show that many remarkable genera, and not a few species, are common to both sides of South America.

The Argentine Flora has little or no general analogy to that of the parts of North America lying in corresponding latitudes on the other side of the Equator. Yet there are some striking, though insulated, points of resemblance. A species of *Cephalanthus* grows on the shores of the Plata; *Æschynomene ciliata*, Vog., is excessively like the North American *Æ. hispida*; there is also a *Pontederia*, extremely near to *P. cordata*, if not a mere variety; and a *Sisyrinchium*, much resembling *S. Bermudianum*.

The Flora of the shores of the Plata offers an extraordinary difference from that of the Cape of Good Hope, lying within the same parallels of latitude, and with nearly the same mean temperature. The many points of analogy, and the general physiognomical resemblance between the vegetation of the Cape and that of New South Wales, have been repeatedly noticed; but between the botany of the Cape and that of La Plata we find scarcely anything but contrasts. The general physiognomy is different; in the Cape Flora there is a great predominance of dry, hard, small-leaved shrubs; and almost all the characteristic families and genera of the one are wanting or insignificant in the other. Almost the only points in the Argentine Flora which strongly remind us of South Africa, are several species of *Oxalis*, and some gay-flowered *Irideæ* and *Amaryllideæ*. The *Cacteæ* of La Plata are represented at the Cape by succulent Euphorbias; and the herbaceous and half-shrubby *Malvaceæ* by the *Hermanniaceæ*. The Flora of Buenos Ayres is also much less peculiar

in its character than that of the Cape. The Argentine region is recognised at once by its Flora as a province of South America; while the botany of the Cape has little resemblance to that of the rest of Africa. The number of endemic genera in the Argentine region is comparatively very inconsiderable, at the Cape remarkably large; the peculiar genera of the former almost always consist of a single, or of very few species, while several of the peculiar Cape genera are very rich in species; and the number of species common to the shores of the Plata and the tropical parts of the same continent is considerable, while very few indeed are common to the Cape and tropical Africa. Local circumstances may account for some of these differences. The Cape, as a botanical region, is almost cut off from the rest of Africa by the great deserts to the north of the Orange River; but no barrier of this sort exists on the eastern side of South America, where (excepting perhaps the case of Patagonia) the limits of the range of plants seem to be fixed by climate alone. Naturalized European plants too have not spread far beyond the neighbourhood of Cape Town, nor do they appear in any remarkable quantity, or at all vie with (much less supersede) the original natives of the soil. This difference does not at all depend on the extent of cultivation in the two regions; the climate, from its greater moisture on the banks of the Plata, may be more favourable to such plants than that of the Cape, but the chief cause of the difference is probably to be found in the soil.

Mr. Brown has indicated a few points of resemblance between the botany of Australia and that of the temperate parts of South America, but all of these belong to Chile; and Mr. Bunbury is not aware of any plant on the eastern side of the continent, within the latitudes in question, that can at all remind us of the Australian Flora. *Proteaceæ*, which are sparingly scattered in Fuegia, Chile, Peru, Guiana and tropical Brasil, appear to be entirely absent.

The author then proceeds to remark upon some of the families contained in Mr. Fox's collections, and on the range of particular species. Under the head of

Filices he contrasts the abundance of species found at Porto Alegre and the neighbourhood (fifty-four in number, and nearly all natives of tropical Brasil) with the poverty of Buenos Ayres, only one fern from the south side of the Plata (a *Blechnum ?*, which seems to agree with the description of *Bl. auriculatum*, Cav.) being contained in the collections. This poverty Mr. Bunbury attributes to the absence of shade and the want of variety of surface, in accordance with which he notices the absence of Ferns, as observed by Martens and Galeotti, from the bare table-land of Mexico, and their great scarcity on the open campos of the interior of Brasil.

Gramineæ.—Mr. Bunbury finds the *Poaceæ* (according to the division established by Mr. Brown) to be rather more numerous in the Argentine region than the *Paniceæ*; but he does not regard the collection as affording a fair representative of the vegetation as regards this family. Besides some European grasses which have become naturalized, there are some apparently indigenous species which

have a very wide range. Such are *Cynodon Dactylon*, apparently a native of all the warmer parts of the world in both hemispheres; *Setaria glauca*, equally cosmopolite; *Setaria Italica*, of which he has specimens also from Louisiana, and which is stated to be a native of Europe, India and New Holland; *Eleusine Indica*, having a vast range in the tropical and subtropical zones; *Polypogon Monspeliensis*, which he has himself seen at the Cape of Good Hope and at Buenos Ayres, as well as in the South of Europe; *Stenotaphrum glabrum*, common to the Cape, Louisiana, tropical Brasil, and the northern shore of the Plata; and to these may be added the beautiful *Eustachys petræa*, if the Cape plant be really the same with the South American.

Eriocauloneæ.—The only species in the collection of this family (so extremely numerous in tropical South America) is *Eriocaulon* (*Pæpalanthus*) *caulescens*, found at Porto Alegre, and also met with in Minas Geraes and in Guiana.

Alismaceæ.—A fine species of *Sagittaria* (probably *S. Montevidensis*, Kunth) is plentiful at Buenos Ayres. It comes very near *S. sagittifolia*, though much larger in the leaves and flowers; but the downy filaments and yellow anthers appear to furnish the most certain distinctive characters.

Compositæ.—Schouw has characterized the countries near the Plata as the "Kingdom of Arborescent *Compositæ*," a title scarcely applicable, these plants, like most others of the region in question, having for the most part an herbaceous character. As in South America generally, they appear to be the most numerous family; almost all belong to the *Corymbiferæ*, and *Cichoraceæ* and *Cynareæ* hardly occur except in a naturalized state. *Labiatifloræ*, so characteristic of the western side of South America and of the Andes, are few and inconspicuous; even the genus *Mutisia* does not extend into La Plata. The shores of the river are characterized by many herbaceous *Helianthæ*; and the genera *Vernonia*, *Baccharis*, and *Eupatorium* (so characteristic of tropical Brasil) extend into this region, but no longer in such amazing numbers. *Helichryseæ*, so prodigiously numerous at the Cape, are comparatively scarce, but the universal genus *Senecio* abounds. Several of the *Compositæ* are tropical species, and some (but these evidently naturalized) are common to both hemispheres.

Asclepiadeæ are as numerous in Rio Grande and in the Argentine region as in South America generally, although by no means rivalling the Cape of Good Hope. *Gomphocarpus fruticosus*, gathered at Monte Video, appears undistinguishable from the Cape plant, but may have been accidentally introduced. With this exception, and that of the genus *Cynanchum*, all the *Asclepiadeæ* belong to strictly American forms, of which *Oxypetalum* predominates.

Umbelliferæ.—The plants of this family in La Plata and Rio Grande chiefly belong to the genus *Eryngium*, and especially to the section with long, narrow, linear or sword-shaped, parallel-veined leaves (or phyllodia), which are often fringed with bristles or with bristle-like teeth. In Mr. Fox's collections are nine species, of which

five belong to this section. One of these (*E. aquaticum ?*) is a conspicuous ornament of the marsh-ditches near Buenos Ayres; and another (seemingly *E. Pristis*) extends from the tropical regions of Brasil as far as 30° S. This part of South America seems to be destitute of those curious *Mulineæ*, which are so characteristic of *Fuegia*, the Chilian Andes and the Falkland Islands; but several European *Umbelliferæ* have become naturalized, and among them the common Fennel, which covers the banks of earth between the cultivated fields in immense profusion, and forms a distinctive feature in the scenery. Mr. Darwin observed the range of the Fennel in the south to be limited by the Rio Salado, rather less than 100 miles south of Buenos Ayres.

Malpighiaceæ.—Only two species are found on the south side of the Plata, viz. *Stigmaphyllum littorale* and *Heteropterys glabra*. In Rio Grande, Mr. Fox collected nine *Malpighiaceæ*, of which one is a *Galphimia*, and the rest belong to *Banisteria*, *Stigmaphyllum* and *Heteropterys*.

Tropæoleæ.—The only plant of this family (the head-quarters of which are evidently on the western side of the continent) found on the eastern side of temperate South America is *Tropæolum pentaphyllum*, abundant in the hedges about Buenos Ayres.

Œnothereæ, Endl.—Some species of *Jussiæa* are plentiful on the marshy shores of the Plata, and Mr. Bunbury possesses three species of *Œnothera* from Buenos Ayres; but *Epilobium* and *Fuchsia* are wanting in the Argentine region.

Melastomaceæ.—One species only, as before mentioned, extends as far south as the Plata, but does not cross the river; and Mr. Bunbury is aware of only nine species from the southern extremity of Brasil.

Leguminosæ by no means form so important a part of the vegetation of the Argentine region as in tropical Brazil, the South of Europe, or Australia. Those of the region in question belong, with few exceptions, to genera widely diffused, such as *Crotularia*, *Lupinus*, *Tephrosia*, *Indigofera*, *Desmodium*, *Æschynomene*, *Lathyrus*, *Clitoria*, *Cassia*, *Mimosa*, *Inga*, and *Acacia*. The observation already made as to the small number of peculiar forms in the Argentine Flora when compared with that of the Cape, and with corresponding latitudes in Australia, is particularly exemplified in this important family. It will be observed also, that all the genera above enumerated (except two, or perhaps three) have their head-quarters within the tropics, and only straggle, as it were, into cooler latitudes; and one is almost tempted to say, that the vegetation of this region is a mere modification, a reduced or dwindled form of the Brasilian, instead of a separate and strongly marked Flora, like that of the Cape. At the Cape *Loteæ* predominate remarkably; in the region of the Plata *Hedysareæ* and *Phaseoleæ* are at least equally numerous. *Cæsalpineæ* and *Mimoseæ* are more numerous on the banks of the Plata than in the same latitudes in South Africa, where south of the Orange River Dr. Burchell knows of only two species of *Acacia*, although these are so abundant (one of them in particular) as to give a distinctive cha-

racter to the scenery. Mr. Fox's collections from Buenos Ayres and Uruguay include five species of *Mimosa*, one of *Desmanthus*, two of *Calliandra*, and five of *Acacia*; yet none of these are so abundant as to form characteristic features of the country. There are several species of *Cassia* natives of Buenos Ayres; but the magnificent *Poinciana Gilliesii*, although well established on the banks of the Plata, is said not to be indigenous. *Daubentonia punicea* was found by Mr. Fox to grow wild sparingly on the bank of the Plata below Buenos Ayres, and in great abundance and beauty on the banks of the Uruguay near its mouth; and Mr. Bunbury thinks it quite possible that Cavanilles, who only saw it in a Botanic Garden, may have been misinformed as to its native country, which he states to be "New Spain," although it is also possible that it may be common to both. Several European species are naturalized at Buenos Ayres, such as *Medicago sativa*, *M. denticulata*, *Trifolium repens*, and *Melilotus parviflora*. *Indigofera Anil*, apparently general throughout the hotter parts of America, was observed by Mr. Fox to be common all through South Brasil and the Banda Oriental, but not to occur south of the Rio de la Plata. *Æschynomene ciliata* ranges at least from Guiana to Buenos Ayres, and, as Mr. Bentham observes, is scarcely distinguishable from the North American *Æ. hispida*, which is found as far north as Philadelphia; and another *Æschynomene* from Buenos Ayres seems to agree with *Æ. conferta* from British Guiana.

June 7.—Thomas Bell, Esq., President, in the Chair.

Mr. Yarrell, V.P.L.S., exhibited a specimen of the Dusky Petrel (*Puffinus obscurus* of modern authors). This bird, new to the British Islands, flew on board a small sloop, off the Island of Valentia, on the south coast of Ireland, on the evening of the 11th of May last. The species having been frequently confounded with the Manx Petrel (*Puffinus Anglorum*), from their close resemblance in plumage, a specimen of the Manx Petrel, together with the eggs of both, was also exhibited for comparison.

Mr. Hogg, F.L.S., exhibited specimens of an umbellate variety of the common Primrose (*Primula vulgaris*, *var.* β. of Smith's 'English Flora'), gathered in Thorp Wood, near Stockton-upon-Tees, on the 12th of May in the present year.

Read some Notes "On the Artificial Breeding of Salmon and Trout, with Remarks on the Modes of Fecundating their Ova." By John Hogg, Esq., M.A., F.R.S., F.L.S. &c.

After referring to his notice of the artificial breeding of Salmon, as practised by Mr. Isaac Fisher, read before the Society on the 4th of May last, and of which an abstract is given in the 'Proceedings,' p. 178, Mr. Hogg gave an account of some further experiments by the same gentleman in the River Swale, made with considerable success, during the past winter and spring. A letter on this subject from Mr. Fisher appeared in the York Herald, dated May 3rd, 1853, from which we learn that ova, placed by him on the 25th of December last in a wooden box with gravel at the bottom, and

through which the stream was continuously flowing, had nearly all produced young salmon by about the middle of April. Some experiments made about the same time by the late Earl of Tyrconnell failed of success from want of attention to the *locale*. Attempts were also made by Henry Coxe, Esq., of Scruton Hall, and Major Wade of Hanxwell Hall, to breed artificially from *Trout*, in which the latter gentleman had succeeded. After pressing the subject on the attention of all who may have the opportunity of making experiments, Mr. Fisher concludes his letter by a caution against what he considers an incorrect statement, taken from the Perth Courier, in which it is said that Dr. Robertson of Dunkeld, "conceiving that the ova of the female were impregnated previous to their development, within the body of the fish," had taken "a number of live female trout from the spawning-bed, and having extracted the roe, deposited them in a perforated zinc box, containing also some gravel," which was "upon the 14th of October last placed in a running stream, and on examining the box [in April], several of the ova were found to be hatched." On this latter experiment Mr. Hogg observed, that the result could only be accounted for by one of the two following methods. Either the ova of the female trout had in some way received the influence of the fecundating principle of the male trout, previous to Dr. Robertson's depositing them in his perforated zinc box; or, the perforated zinc box, which contained the ova as expressed from the females, was placed in the running stream within the fecundating influence of the males. The former solution he founds on the mode of spawning described by Mr. Ellis in his 'Natural History of the Salmon,' from which it would appear that the male and female fishes having jointly made a furrow in the gravel, place themselves one on each side of it, and throwing themselves on their sides "again come together, and rubbing against each other, both shed their spawn into the furrow at the same time. This process is not completed at once; it requires from eight to twelve days for them to lay all their spawn." Mr. Hogg argues from this description, that it is possible that the female trout from which Dr. Robertson took the ova might have gone through this process with the male, and might have thus received the fecundating influence, just before she was caught; but on this solution he does not rely. He thinks it more probable that in the running stream in which the perforated zinc box was placed, there were some male trouts which had deposited their milt near the box, and that some of the milt might have been carried with the stream through the holes of the box, and have so fecundated the ova within it. In conclusion, he suggested, that as doubts still exist as to the processes which the male and female salmon and trouts naturally adopt at the spawning season, experiments on the subject might readily be undertaken, by confining them, at the proper seasons, in large glass cases or tanks, covered over with a coarse wire gauze, such as those which have recently been constructed in the Water-vivary of the Zoological Gardens, as a name for which he suggests the word *Hydrozogrium*, compounded of ὕδωρ, *aqua*, and ζωγρεῖον, *vivarium*.

A stream of fresh water, regulated by pipes, could easily be supplied in all districts where the Salmon-tribe abounds.

Read also "Notes on the Dipterous parasites which attack the common Earwig and the Emperor Moth." By George Newport, Esq., F.R.S., F.L.S. &c.

After remarking that it is well known to naturalists that many Dipterous insects of the family *Tachinariæ* infest the *Lepidoptera*, *Hymenoptera* and *Coleoptera*, Mr. Newport stated that he has recently found one of the *Dermaptera*, also the common Earwig, to be subject to the attacks of a species of the same family. He has obtained this parasite, both in its larva and pupa state, from earwigs collected in the autumn in the neighbourhood of London. The earwig is attacked during its larva, or in the earlier period of its pupa state, when the covering of its body is soft and easily perforated. The fly then attaches a single egg to some part of its surface, and the young parasite hatched from this penetrates into the abdomen of its victim, and there continues to feed until it is full-grown; which is not until some days, and sometimes even weeks, after the earwig has assumed the *imago* state. The larva then escapes by forcing itself between the segments of the earwig's body, and the victim, already rendered sterile, soon dies. The larva at first moves about very quickly, but soon becomes quiet and changes to the pupa condition, usually within a couple of hours. When this state is assumed during the summer, or in the early part of the autumn, the fly is produced in about a fortnight or three weeks, according to the temperature of the season; but when the earwig's body is not left until late in the autumn the pupa remains through the winter in the earth, and the fly makes its appearance in the spring; and this also is the case when the larva remains in the earwig's body during winter, and assumes its pupa condition in the spring or early part of summer.

The body of the *larva* is about three-tenths of an inch in length, is soft, white, and tapers anteriorly to a very small but distinct head, which is furnished with a pair of retractile hooks. The body is formed of twelve distinct segments, including the head, and posteriorly has two projecting, corneous, black, tubular breathing organs. The *pupa* is oval, smooth, and of a dark brown colour, and retains the breathing organs of the larva projecting obliquely outwards on either side, at its posterior extremity. The *imago* fly appears to be referable to the genus *Metopia* of *Meigen*, and the author proposes to designate it *Metopia Forficulæ*, and to distinguish it as follows:—

Genus Metopia, Meig.

Metopia Forficulæ, cinerea, oculis testaceis, antennis nigris, corpore pedibusque pilis longis nigris vestitis; thoracis pilis lineas 6 longitudinales efformantibus, scutello alarum basi femoribusque ferrugineis.
Muscâ domesticâ aliquantò minor; Forficulas prope Londinum infestat.

The author also exhibited specimens of another parasite of the same family, *Exorista larvarum*, which he had bred from pupæ of the Emperor Moth, *Saturnia Pavonia minor*. This species is con-

stantly seen in the early part of summer, in the hot sunshine, on hawthorn hedges, when the larvæ of Pavonia are feeding. It appears to be the common parasite of the Emperor Moth, in one cocoon of which were the dead pupa of the moth, together with ten living pupæ of the fly. In other cocoons there were nine, seven, six, four three, and two respectively, and in one instance only a single parasite. The pupa of the moth, in each instance, had been perforated by the parasites, which thus appear to effect their escape into the cocoon, in the larva state, and then into pupæ; as is the case with the Hymenopterous larva of *Ophion luteum* which infests the puss moth. The pupa of this parasite on Pavonia differs from that of the Earwig in its surface retaining distinct roughened annular indications of the twelve segments of the body of the larva, and also in the breathing organs being marked by three slight protuberances on each side, at the posterior extremity, above the anus.

The author also described and exhibited two remarkable cocoons of the Emperor Moth. One of these had two perfect outlets, but in other respects was a single cocoon, and had contained only one pupa from which the moth had been developed. The other was a large flattened cocoon, which, examined externally, appeared but as a single structure, but when opened was found to have been the joint production of *two larvæ*. It was divided internally, by a septum, into two chambers, to which, however, this double cocoon had but one outlet. One of the larvæ had died before changing to a pupa. The other had changed and had afterwards produced the moth, but which had been unable to liberate itself from the cocoon, owing to the obstacle opposed to its egress by the septum. It had become impacted, and had died in the cocoon in its attempts to escape through the outlet.

June 21.—Thomas Bell, Esq., President, in the Chair.

Read a "Sketch of the Vegetation around Wellington, New Zealand." By T. S. Ralph, Esq., A.L.S.

This sketch was prepared by Mr. Ralph, during his voyage above alluded to from Wellington to Port Phillip, from his notes made upon the spot. He describes the town of Wellington as situated at the southern extremity of a large port, of about 9 miles in length and varying in breadth from 4 to 6 miles, surrounded by hills which are in many places covered to their summit with trees and shrubs. These hills, being composed almost entirely of a claystone rock, present a marked feature of roundness and abruptness without sharpness, and precipitous declivities full of channels and gullies from top to bottom. Wellington itself is built on two flats, with an intervening beach-line of houses to connect them, so that the town possesses but a small space of level land, which some ten years since is said to have been covered with dense bush, in which the settlers had no difficulty in losing themselves. But all the hills in the vicinity of the shore have had their timber felled, and the ground has since become covered with an undergrowth, chiefly composed of *Lepto-*

spermum scoparium and *L. ericoides* (together known by the name of *Manukà*), *Friesia racemosa* (*Aristotelia serrata* of Dr. J. Hooker's Fl. Nov. Zel.), *Myoporum lætum*, and in some places *Myrtus bullata*. A few of the deep gullies at the back of the first ridge are uncleared, and contain besides some Arborescent Ferns; but the hills in the rear of the town retain, especially on their upper parts, their older clothing of bush, consisting chiefly of some trees, such as *Fuchsia excorticata*, *Knightia excelsa*, *Elæocarpus Hinau*, two or three species of *Coprosma*, *Geniostoma ligustrifolium*, *Drimys axillaris*, *Pittosporum tenuifolium*, *Brachyglottis repanda*, and a few specimens of *Br. rotundifolia*. These are, in the denser parts of the bush, accompanied by *Piper excelsum*, *Ripogonum parviflorum* (or Supple-Jack), climbing species of *Metrosideros*, and *Dicksonia squarrosa* and *Cyathea dealbata*, which are the commonest species of Tree-ferns. *Cyathea medullaris* Mr. Ralph found but once in this locality; and of *C. dealbata* he mentions having found a single specimen with a trifurcate stem, about 12 or 14 feet in height, and each of its divisions rising close to each other to a height of 4 feet. Smaller ferns, such as *Hymenophyllum demissum* and *H. dilatatum*, accompany these; *Trichomanes reniforme* is occasionally met with in extensive patches; and *Polypodium Billardieri* is by far the commonest of climbing ferns. During the winter season (generally from May to September) the gullies, being furnished with a steady supply of water, produce numerous Cryptogamic plants, which Mr. Ralph states that he has closely observed, but of which he can at present give only a brief notice. Of most of these he expects to be able to obtain the fructification, by subjecting them to a period of confinement in Ward's cases, in which with a less moist, but more regularly charged atmosphere, they seem well disposed to fruit. He has thus succeeded in fruiting *Jungermannia hymenophylloides*; and suggests this mode of cultivation to those who are desirous of obtaining fruiting specimens of Mosses, *Jungermanniæ*, &c. Of *Fungi* Mr. Ralph has collected about thirty species, while the list given in M. Raoul's work includes only eleven or twelve. He particularly notices *Ileodictyon cibarium*, which makes its appearance in June and July soon after heavy falls of rain, and a brick-red *Polyporus* (*P. sanguineus* of the 'Voyage au Pole Sud'?) as abundant in some places. He is inclined to think that in many instances mere varieties have been described as species. Thus he thinks that the two so-called new species of *Parsonsia* described in M. Raoul's 'Choix des Plantes' are only varieties of *P. heterophylla*; he has been unable to distinguish the two supposed species of *Drimys*; and in other instances he believes the differences to depend mainly upon the climate, temperate enough in sheltered situations, but severe in places exposed to the cold south-easterly gales either of winter or summer. Among the microscopic *Fungi*, Mr. Ralph particularly mentions a species of *Trichia*; the common *Æcidium Senecionis* which accompanies the *Senecio vulgaris*, and appears to him to extend to a species of *Epilobium*; and *Perisporium vulgare*? attacking *Aristotelia* in winter. Of *Aristotelia* he observes that although it is said to be exstipulate, he has met with several spe-

cimens in which the stipulæ were largely developed. Of introduced plants, the common water-cress grows by cart-loads in and about the streams for several miles round Wellington; and *Mimulus luteus* is also spreading itself along the streams and over the swampy places behind the town. He adds that he is very desirous of introducing some of the British plants which would probably thrive, such as *Stellaria Holostea* and *Antirrhinum Cymbalaria*; and states that he brought out with him from England *Vallisneria spiralis*, of which he has specimens intended for the Botanic Garden at Melbourne, from whence it may perhaps make its way to Sydney and Hobart Town. Mr. Ralph concludes his sketch by mentioning a species of *Nitella* (*N. translucens*?) found in a rapid stream about five-and-twenty miles from Wellington.

MISCELLANEOUS.

On the Mode of Reproduction and Development in various groups of Zoophytes and Mollusca. By M. Gegenbaur.

Acalephæ.

1. In a new species of *Lizzia*, the development of the ova takes place in the following manner:—After exclusion from the ovary, which is rent at its external portion, the mature eggs become furrowed; a ciliated oval embryo is then formed, which is soon converted into a polypiform larva. This larva, after fixation, acquires a transparent corneous envelope, and throws out from a little below its extremity, four arms disposed in the form of a cross, whilst the mouth makes its appearance at the apex. The embryo of the Medusa has thus become a Polype, which resembles the genus *Stauridium* of Dujardin.

2. In a discophorous Medusa, the author saw gemmules arising in great quantity from the inner surface of the stomach; these gemmules at first presented the appearance of flat tubercles, which, becoming detached from their parent, gradually acquired the form of a bell. On the lower surface of this bell, near its circumference, four protuberances made their appearance; in its centre a small opening, the mouth was formed; the protuberances, which are marginal tentacles, soon increased in number, whilst the embryo continued growing. At last these gemmules, the whole development of which took place within the stomach of the mother, produced Medusæ, which did not differ from their parent in any respect.

3. The author considers that in a considerable number of genera, such as *Charybdea*, *Pelagia*, *Ephyropsis* (new genus), and *Rhizostoma*, the marginal organs are composed of an auditory apparatus and an organ of vision. The latter, which have hitherto only been seen by M. Kölliker in an *Oceania*, are placed close to the auditory vesicles, and attached to a prolongation of the stomachal sacs; they consist of a hemispheric mass of pigment-cells, in which a spherical

lens is half-buried; the free portion of this lens is perfectly naked and bathed by the sea water.

Siphonophora.

1. The genus *Eudoxia* lately studied by M. Busch is distinguished by the possession of two organs serving for generation; one of these is the natatory bell of the animal which contains either an ovary or a testicle at its bottom. The other, which is smaller, and fixed at the base of this bell, has a certain resemblance with the medusiform gemmules of polypes, which has led M. Busch to the opinion that the *Eudoxiæ* produced Medusæ. This opinion does not agree with the author's observations; he has seen very distinctly that the organ in question is only a natatory bell containing the organs of generation and serving to replace the other after it has detached itself.

2. With regard to *Abyla pentagona* the author has made a discovery which will serve to elucidate the history of the *Siphonophora* with a single sucker. A small siphonophorous Medusa of the *Eudoxia* type, which occurs very frequently in the port of Messina, and which possesses all the organs of the *Eudoxiæ*, including those of generation, was found to be nothing but a detached portion of an *Abyla*. That is to say, the fully developed *Abylæ* consist of a great number of Eudoxiiform animals, which become detached and lead an independent existence. Each of these animals possesses a trunk or sucker (polype according to M. Vogt) with a tentacle, a natatory bell, containing the organs of generation, and a protective portion resembling a cube. This latter portion has not hitherto been observed, which accounts for the relation between the *Abylæ* and *Eudoxiæ* having escaped the notice of MM. Quoy and Gaimard, and M. Kölliker.

3. With respect to the *Velellæ*, the author believes he has observed a Medusa which is an ulterior development of the gemmules of these animals, which are attached to the smaller suckers. The youngest of these Medusæ resembled the detached gemmules described by Huxley, whilst the larger ones possessed a stomach and well-developed organs of generation, but no marginal corpuscles, and only one tentacular cirrus.

4. During last winter, the author attempted the artificial fecundation of the *Siphonophora*. He succeeded completely with the genera *Diphyes, Physophora, Agalmopsis, Hippopodius*, and *Forskahlia*. The development of the egg commenced with a complete wrinkling of the yolk; an embryo resembling a ciliated Infusory is then formed. Its further development was only observed in the genus *Diphyes*; the first portion of the *Diphyes* which makes its appearance is the upper part of the body and the natatory bell. M. Gegenbaur found a great number of young *Physophoridæ* very similar to those described by M. Kölliker.

Pteropoda and Heteropoda.

1. The author has observed the embryos of nearly all the genera inhabiting the Mediterranean, viz. *Carinaria, Firola, Atlanta, Hy-*

alea, Cleodora, Tiedemannia, and *Pneumodermon.* In all, with the exception of *Pneumodermon,* the development of which has been described by Müller (Monatsbericht der Kön. Akad. der Wiss. zu Berlin, October 1852), and by Kölliker and Gegenbaur (Zeitschrift für Zoologie, Bd. iv.), an oval embryo is formed, furnished with membranous ciliated lobes (*velum*) and a shell (even in *Firola*). In the Pteropoda this *velum* is persistent, and becomes transformed into the finlike lateral appendages of these animals. In the Heteropoda, on the contrary, it gradually disappears as the animal acquires its characteristic form. The velum of the Heteropoda and Pteropoda corresponds exactly with that of the Gasteropoda, from which it follows that the lateral lobes or fins of the Pteropoda, which are only an ulterior metamorphosis of the velum, cannot be compared with the foot of the Gasteropoda, as was Cuvier's opinion.

2. Lastly, the author has ascertained that in many Mollusca the generative organs contain both eggs and spermatozoa. The excretory canal of these organs is not double, or furnished with two semi-canals, as was supposed by Meckel, but contains at once eggs and spermatozoa: this was shown by H. Müller of Wurzburg to be the case in *Phyllirhoë.*—*Comptes Rendus,* Sept. 26, 1853, p. 493.

TEETH OF TESTACELLUS AND GLANDINA.

M. Moquin-Tandon, in the 'Journal de Conchyliologie' (ii. 125), describes the teeth of *Testacellus,* and among other particulars states that the animal has no horny jaws, a retractile proboscis, and is carnivorous.

M. Morelet (in vol. iii. pp. 27 & 257) and M. Raymond (in vol. iv. p. 14 of the same Journal) describe the animal of two species of *Glandina* from America and Africa as having nearly similar teeth, a retractile proboscis without a horny jaw, and the same carnivorous appetite. The latter author considers *Testacellus* as "a *Glandina* with a rudimentary shell." Dr. Wyman described and figured the teeth of *Glandina* in the 'Boston Journal of Natural History,' showing them to be of a conical form.

I intended, in my paper on the Teeth of Pulmonata in the last Number, to have observed, that the illustrations of that paper were kindly drawn by Mr. S. P. Woodward from the well-mounted specimens of Messrs. Cocken and Wilton. The examination of the large series of mounted specimens belonging to these gentlemen and other microscopists, has been very useful to me in these researches, as showing the uniformity and permanence of the characters afforded by the teeth, and sometimes of drawing my attention to peculiarities of form, and inducing me to examine the teeth of the animal they were said to be taken from.—John Edward Gray.

On the Structure of the Retina in Man. By Profs. Kölliker and H. Müller.

The retina is composed of different layers—viz. 1. the layer of cylinders and cones; 2. that of nucleiform bodies; 3. the layer of

gray substance; 4. the expansion of the optic nerve; and 5. the limiting membrane.

Leaving the latter membrane out of the question, we will commence with the layer of the optic nerve. The most remarkable fact to be noticed here, is that according to a discovery of M. Kölliker, the expansion of the optic nerve is interrupted at the *macula lutea*, so that at that place there does not exist the smallest trace of a layer of nervous fibres. In all other parts of the retina the nervous fibres form a very thick and uninterrupted layer at the bottom of the eye; except that at the margins of the *macula lutea* they are lost in a layer of nervous cells, which here form the most internal layer of the retina, and are only covered by the limiting membrane. These cells form a very thick layer in this place, as in a vertical section of the retina, from nine to twelve series of cells placed one behind the other may be seen; these cells possess the characters of the other cells of the retina, which will be referred to hereafter.

With respect to one of the most important questions, the termination of the nervous fibres of the retina, the observations of M. Kölliker upon the human retina show that these fibres are in direct communication with the nervous cells. These cells, which are entirely absent at the entrance of the optic nerve, are all provided with from one to six processes, exactly resembling those found in the nervous cells of the brain and ganglions; these, ramifying several times, are continuous with the true nervous fibres of the expansion of the optic nerve, so that these fibres take their rise in the nervous cells of the retina. The discovery of this important fact is due to the Marquis A. Corti, of Turin, who ascertained it, first, about three years ago in the ruminants and afterwards in the elephant, in which animal the origins of the optic fibres are presented with unparalleled distinctness and beauty. We have verified the facts ascertained by M. Corti on the human retina, and think we may say that in man, as in the other mammalia, there are terminations of the nervous fibres in the cells of the retina. As to free terminations, we have never found them, and we are inclined to believe that, although admitted by several authors, they have no existence in fact.

Next to the nervous fibres and cells, the parts most worthy our attention are the cylinders and cones. The former have been well described by Hannover; but the cones of the retina of man and mammalia have not been sufficiently seen by any observer. The cones are pyriform or conical bodies, three or four times the thickness of the cylinders, but not half their length, situated in the interior of the layer of cylinders. The cones, which on their outer slender portion bear a prolongation resembling a short cylinder, are less numerous than the cylinders; they are tolerably regular in their arrangement. At the position of the *macula lutea*, as observed by Henle, there are no cylinders, whilst the cones are very numerous and form an uninterrupted layer.

One of the facts most worthy attention is, that from the internal portion of each cone and from each cylinder a fibre proceeds, which, after traversing all the layers of the retina, loses itself on the inner

surface of the limiting membrane. This has also been ascertained by Müller to be the case with animals. These fibres, which are all in relation with the nucleiform bodies, of which, as already pointed out by Bowman, there are two layers in the human retina, form a peculiar system of the retina, and are named by us the *radiating fibres*. The principal facts which we have ascertained respecting these fibres, which have hitherto remained unknown, are as follows: every cone at its inner portion is in connexion with an enlarged body containing a nucleus, which is situated in the outer layer of nucleiform bodies; and from this enlarged body, which may be regarded as a cell, a fibre arises, which attains the inner layer of the nucleiform bodies and there becomes connected with one of these, which are only small cells containing a large nucleus; this fibre then traverses the nervous cells and fibres, and at length attaches itself by its extremity, which is inflated and sometimes ramified, to the limiting membrane.

Radiating fibres, exactly resembling these, but finer, also rise from the inner portion of the cylinders, become connected with those nucleiform bodies in the two layers which are not fixed to the fibres proceeding from the cones, and terminate in the same manner at the limiting membrane; it is to be observed, however, that from three to six of the fibres proceeding from the cylinders unite during their passage through the inner layers of the retina so as to form a single fibre, which renders the radiating fibres less numerous in the inner layers. These radiating fibres, like the nervous fibres of the retina, are very delicate, but they never form varicosities, and may thus be distinguished from the true nervous fibres.

Such are the principal facts which we have ascertained with respect to the anatomy of the human retina, and from these physiology may derive certain conclusions of indubitable interest. We establish, in the first place, that it is not by the nervous fibres of the retina that light is perceived, because, on the one hand, that part of the retina which is most sensible to light and which offers the most perfect visual perception, the *macula lutea*, does not exhibit the least trace of the layer of nervous fibres, whilst, on the other hand, the nervous fibres exist in great number at that point where the retina is totally deficient in sensibility. This settled, there only remain the nervous cells of the retina, the nucleiform bodies, and the cones and cylinders, which can be considered as organs of sensation. For our own parts, we should be inclined to regard the nervous cells as fulfilling this function, as it has been shown, both by Corti and ourselves, that the nervous fibres of the optic nerve are continuous with these cells; we are, nevertheless, compelled to lay aside this supposition, as in all parts of the retina which possess the faculty of perception, these cells form several series (ten or twelve) laid one upon another, and it is impossible to admit that we could receive exact and distinct visual impressions, if each ray of light influenced at once ten or twelve cells. The same reason leads us to think that it is not by means of the nucleiform bodies that we receive the impression of light, so that only the cones and cylinders remain for our purpose. We are led to form the opinion that these curious organs, with which physiology has hitherto

been puzzled what to do, are truly the parts destined to receive the impression of light, and we at the same time think that their arrangement side by side in the manner of a mosaic, and their small diameter, are all favourable for rendering the visual sensations as exact as possible. We do not, however, wish to insist too strongly upon this hypothesis, as we have been unable to discover any connexion between the cones and cylinders and the nervous fibres and cells of the retina. We suppose that such a connexion exists, but we have found it impossible to prove it distinctly. All that we have seen is,—

1. That all the nervous cells possess one or two processes, which, proceeding from their external portion, lose themselves in the inner layer of nucleiform bodies; and,

2. That the nucleiform bodies of this layer have generally one or two processes besides the two which are continuous with the radiating fibres mentioned above.

It may be, as indeed we suppose, that these latter fibres are in direct communication with the external prolongations of the nervous cells, so that sensations originating in the cylinders and cones would be transmitted by the radiating fibres to the nervous cells, and thence to the fibres of the expansion of the optic nerve, which would thus become only a means of communication between the organs which perceive the light (the cones, cylinders and nervous cells) and the brain.

In any case, even should our hypothesis of the function of the cylinders and cones be proved false by subsequent discoveries, it will always be certain that the fibres of the optic nerve are not directly acted upon by the light, and that we must seek for the organ of the direct sensation of light in the nervous cells of the retina, whether these cells be directly affected by the luminous rays or by the medium of the cones and cylinders. We admit that the layer of nervous cells in the retina is a true ganglion, or if it be preferred a true nervous centre. We attribute to it the function of the perception of light, and believe that the optic nerve serves merely to transmit the sensations from this centre to the organ of intelligence and consciousness.—*Comptes Rendus*, 26th September, 1853, p. 488.

Discovery in the Human Body of a Substance giving the same Chemical Reactions as Cellulose. By M. Virchow.

M. Purkinje has described some peculiar corpuscles from the human brain, formed of concentric layers and of a structure analogous to that of starch grains. These amylaceous bodies have since been found in several parts, especially in the superficial layers of the walls of the cerebral ventricles and in the spinal cord. Some observers have supposed that it was this substance that constituted the *acervulus cerebri*.

In investigating the microchemical properties of these corpuscles, the origin of which is unknown, I was much surprised to find, that on the addition of watery solution of iodine a bluish tint made its appearance, contrasting strongly with the yellow coloration of the neighbouring parts. The addition of hydrated sulphuric acid to the object immediately produced that bright violet colour so especially characteristic of vegetable cellulose. The repetition of the experi-

ment proved the constancy of the reaction, which is more brilliant in proportion as the action of the sulphuric acid is slow.

These particles of cellulose (true amylaceous corpuscles) only exist in the vicinity of the cerebral ventricles, especially in the deep layers of the ependyma in the nerves of sensation and in the spinal cord. They are very frequent in the latter in the central gray substance described by M. Kölliker, which, according to my observations, extends from the ependyma of the fourth ventricle to the terminal filament of the spinal cord, and corresponds to the ependyma of the obliterated central canal of this portion of the nervous axis. On this account it might be called the *central cord of spinal ependyma.*

All the other concentric corpuscles have a different composition. Neither the concretions of the pineal gland and choroid plexus, nor the granules of the excrescences of Pacchioni, nor the plates extracted from the spinal arachnoid, exhibit any vegetable reaction. The corpuscles of cellulose are quite peculiar to the ependyma, which is neither a prolongation of the arachnoid, nor of the *pia mater*, but rather the superficial free layer of the connective tissue of the nervous elements. It is on this account that these granules are also found in the gray substance of the olfactory nerve.—*Comptes Rendus*, Sept. 26, 1853, p. 492.

METEOROLOGICAL OBSERVATIONS FOR OCT. 1853.

Chiswick.—October 1. Heavy clouds: clear. 2, 3. Clear and fine: frosty at nights. 4. Rain. 5. Constant rain. 6. Dense fog. 7. Hazy and damp: fine: rain. 8. Rain: fine: clear. 9. Foggy: fine. 10. Very fine. 11. Fine. 12. Rain. 13. Hazy: rain. 14. Foggy: very fine. 15. Fine: cloudy: rain at night. 16, 17. Rain. 18. Clear and fine. 19. Heavy rain. 20. Fine. 21. Rain. 22. Rain: fine. 23. Densely overcast: cloudy and fine. 24, 25. Fine. 26. Very fine: rain at night. 27. Cloudy: overcast: lightning in the evening: rain. 28. Cloudy and fine: rain. 29. Cloudy and fine: clear. 30. Foggy: clear. 31. Very fine.

Mean temperature of the month ..... 49°·99
Mean temperature of October 1852 ..... 46 ·22
Mean temperature of Oct. for the last twenty-seven years . 50 ·06
Average amount of rain in Oct. ..... 2·64 inches.

Boston.—Oct. 1. Cloudy: rain A.M. 2. Fine: rain P.M. 3. Fine. 4. Rain A.M. 5. Cloudy: rain A.M. and P.M. 6. Rain A.M. 7. Cloudy. 8. Cloudy: rain A.M. and P.M. 9. Cloudy. 10. Fine: rain P.M. 11. Cloudy: rain A.M. and P.M. 12. Cloudy: rain A.M. 13, 14. Cloudy: rain P.M. 15. Cloudy. 16. Rain A.M. and P.M. 17. Cloudy: rain A.M. and P.M. 18. Cloudy. 19. Cloudy: rain A.M. and P.M. 20. Cloudy. 21. Cloudy: rain A.M. 22. Fine. 23, 24. Cloudy. 25. Foggy. 26. Cloudy: rain P.M. 27. Cloudy. 28. Cloudy: rain A.M. 29. Cloudy. 30, 31. Fine.

Sandwick Manse, Orkney.—Oct. 1. Showers A.M. and P.M. 2, 3. Sleet-showers A.M. and P.M. 4. Rain A.M.: showers P.M. 5. Showers A.M.: drizzle P.M. 6. Bright A.M.: cloudy P.M. 7. Drizzle A.M.: rain P.M. 8, 9. Damp A.M. and P.M. 10. Cloudy A.M. and P.M. 11. Showers A.M.: cloudy P.M. 12. Cloudy A.M.: damp P.M. 13. Cloudy A.M. and P.M. 14. Cloudy A.M.: showers P.M. 15. Bright A.M.: showers P.M. 16, 17. Showers A.M. and P.M. 18. Showers A.M.: bright P.M. 19. Cloudy A.M.: rain P.M. 20. Clear A.M.: showers, aurora P.M. 21. Rain A.M. and P.M. 22. Clear A.M.: showers P.M. 23. Clear A.M.: showers, aurora P.M. 24. Cloudy A.M.: drizzle P.M. 25, 26. Cloudy A.M.: rain P.M. 27. Bright A.M.: clear, aurora P.M. 28. Cloudy A.M. and P.M. 29. Bright A.M.: cloudy P.M. 30. Clear, fine A.M: cloudy P.M. 31. Rain A.M.: showers P.M.

Mean temperature of Oct. for twenty-six previous years ..... 47°·64
Mean temperature of this month ..... 48 ·66
Mean temperature of Oct. 1852 ..... 46 ·88
Average quantity of rain in Oct. for thirteen previous years . 4·99 inches.

Meteorological Observations made by Mr. Thompson *at the Garden of the Horticultural Society at* CHISWICK, *near London; by* Mr. Veall, *at* BOSTON; *and by the* Rev. C. Clouston, *at Sandwick Manse,* ORKNEY.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston.	Orkney, Sandwick.		Chiswick.		Boston.	Orkney, Sandwick.		Chiswick.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1853. Oct.	Max.	Min.	8¾ a.m.	9¼ a.m.	8½ p.m.	Max.	Min.	8½ a.m.	9¼ a.m.	8½ p.m.	1 p.m.					
1.	29·631	29·601	29·17	29·40	29·46	61	34	50	48	43	w.	w.	calm	.....	.....	·49
● 2.	29·861	29·730	29·40	29·62	29·72	54	27	43	43	42	nw.	w.	nw.	.....	·07	·20
3.	30·043	29·988	29·68	29·81	29·71	55	28	36·5	45	45½	n.	nw.	ssw.	.....	·06	·22
4.	29·965	29·608	29·50	29·23	29·16	58	52	45	47	52	sw.	s.	wsw.	·33	·17	·46
5.	29·407	29·263	29·03	29·38	29·68	57	38	55	52½	48	s.	sse.	ne.	·32	·04	·66
6.	29·401	29·371	29·00	29·84	29·80	53	47	53	48½	47	sw.	n.	ne.	·08	·36	·03
7.	29·418	29·389	29·03	29·68	29·64	56	47	52	50	51	sw.	calm	e.	·12	·05	·07
8.	29·475	29·469	29·10	29·69	29·80	60	41	54	53	53	nw.	se.	e.	·46	·08	·20
☽ 9.	29·743	29·586	29·26	29·92	30·02	62	35	52	53	52½	sw.	e.	se.	.....	·07	·01
10.	29·886	29·697	29·40	30·04	30·02	62	48	57	53	50	n.	nne.	ne.	·05	.....	.....
11.	29·717	29·657	29·34	29·96	29·95	58	42	53	51	48	ne.	nne.	nne.	·12	·03	·01
12.	29·684	29·634	29·36	29·93	29·96	57	49	55	49	47½	e.	ne.	ne.	·19	·05	.....
13.	29·714	29·664	29·40	29·96	29·94	58	50	55·5	48	46	e.	ne.	calm	·08	.....	.....
14.	29·745	29·672	29·40	29·74	29·40	64	36	53·5	46	49	s.	ne.	sse.	·16	·10	.....
15.	29·657	29·522	29·22	29·09	29·05	58	42	50	52	48½	sw.	sw.	ssw.	·04	·02	·07
16.	29·401	29·318	29·00	28·97	28·97	54	28	49	47	47	ne.	ssw.	wnw.	·32	·25	·08
○ 17.	29·242	29·070	28·93	29·02	29·22	56	33	41	48	45	sw.	sse.	nnw.	·31	·18	·30
18.	29·447	29·396	29·10	29·36	29·47	57	34	41	46	43	w.	wnw.	nne.	.....	·37	·17
19.	29·152	28·940	28·94	29·48	29·42	53	46	47·5	46	44	e.	se.	s.	·36	.....	.....
20.	29·810	29·373	29·04	29·38	29·45	56	32	49	46½	47	nw.	ne.	w.	.....	·44	·65
21.	29·854	29·753	29·43	29·14	28·95	60	50	47	49	51½	sw.	s.	sw.	·08	.....	·22
22.	29·937	29·814	29·36	29·03	29·50	64	53	55	51	47	sw.	ssw.	ssw.	.....	·04	·56
23.	30·080	29·970	29·54	29·40	29·80	65	42	59	50½	46½	sw.	sw.	w.	.....	.....	·14
24.	30·063	29·886	29·62	29·81	29·53	62	44	53·5	51	54	s.	sse.	se.	.....	.....	·13
☾ 25.	29·825	29·722	29·38	29·48	29·62	63	40	52	57	45½	s.	s.	sse.	.....	.....	·03
26.	29·702	29·654	29·34	29·80	29·62	67	47	54	47	49	s.	sse.	ese.	·20	.....	·84
27.	29·648	29·568	29·27	29·53	29·53	64	52	56	53½	51	s.	ese.	sse.	·36	·12	·08
28.	29·593	29·493	29·12	29·52	29·36	61	47	57	50½	51	s.	s.	w.	·20	·10	·01
29.	29·947	29·822	29·36	29·55	29·75	56	37	50	48	46	sw.	wsw.	w.	.....	·10	·03
30.	30·056	29·992	29·66	29·83	29·65	54	32	46	49	47½	ne.	wsw.	sse.	.....	.....	·03
31.	29·957	29·879	29·55	29·42	29·40	57	45	45	49	51½	s.	s.	se.	.....	.....	·25
Mean.	29·711	29·596	29·29	29·548	29.566	58·77	41·22	50·5	49·29	48·04				3·78	2·70	5·94

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